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Forthcoming Event.

SEPTEMBER 27—OCTOBER 1.
International Foundrymen's Congress and Exhibition at Detroit, U.S.A.

THE FOUNDRY TRADE JOURNAL IS THE OFFICIAL ORGAN OF THE INSTITUTE OF BRITISH FOUNDRYMEN; THE WELSH ENGINEERS' AND FOUNDERS' ASSOCIATION, AND THE FOUNDRY TRADES EQUIPMENT AND SUPPLIES ASSOCIATION.

Institute of British Foundrymen.
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Secretary: K. S. Bridges, Avenue Chambers,
Southampton Row, London, W.C.1.

The Possibilities of Pulverised Fuel in the Foundry.

In pulverised fuel we have at the same time the most efficient, economical and flexible method of burning solid fuels. In the United States of America the use of powdered fuel has been steadily growing over a period of years, and to-day there are few forms of heating to which the system has not been adapted. When it is understood that in the metallurgical industries alone the annual consumption is upwards of 15 million tons it will be appreciated that firing with pulverised fuel has long since passed the experimental stage. In the foundry pulverised fuel is being used for crucible and reverberatory furnaces, annealing stoves, core and drying ovens, with, it is claimed, a saving of labour equal to 70 per cent., and a saving in fuel costs of some 20 per cent. Labour saving is accounted for by the reduction in coal handling, stoking, ash handling and disposal. The saving in fuel is not wholly accounted for by the reduction in tonnage, but is due in the first instance to the fact that the finest of the fuel, duff, whilst it is eminently suitable for pulverised fuel firing, is the cheapest form of fuel, in many cases merely of nominal value. With powdered fuel firing also it is possible to use almost the exact volume of air necessary for perfect combustion. It will be found that the carbon content in the flue dust is less than is possible with even the most efficient mechanically stoked or hand-fired furnace.

In view of the foregoing it is somewhat remarkable that there has hitherto been such little consideration given to the application of this mechanical gas to our foundry industries in this country. Doubtless there is still existing a certain measure of distrust because coal dust is highly explosive. So, too, is blast furnace gas, producer gas or even the charge in a Diesel engine. With these three last we have the confidence borne of experience, but it is quite certain that properly harnessed pulverised fuel is equally safe. We do not advocate, still less encourage, the use of low-grade fuels. Those should be left for the collieries to burn. It may, however, be noted as an interesting fact that if low-grade fuels are to be burnt the efficiency of the pulverised installation over that of mechanical stoking or hand-firing increases as the dirt content goes up.

There is also a feeling that the use of pulverised fuel may adversely affect the metal in the reverberatory furnace. That this is not the case is evidenced by the use of powdered fuel in the reverberatory furnaces for smelting copper. That metal is certainly more prone to oxidation than is iron.

It may be asked how are we to apply a system of pulverised fuel firing to meet foundry requirements. Generally, it will be more convenient and also more economical to work upon a unit system, thus the crucible furnace, the reverberatory furnace and the annealing furnace would be equipped with their own pulverising and firing unit. In the case of the drying ovens that which would best seem to meet the case would be two units, which would normally feed into a common main direct into a furnace, the hot gases from which would be conveyed to the various ovens in the battery. With the adoption of the unit system it would be advisable to employ a standard sized unit: it would then only be necessary to hold one unit as a stand-by, and obviously in this system as the coal is only pulverised immediately before it is fired there is no question of additional storage. In foundries of considerable size, or where they form a portion of a works in which the boilers are also fired with pulverised fuel, the central system might be advantageously adopted. In this case it will be understood a supply of powdered fuel is carried centrally to the consuming plants.

Hitherto we have only dealt with the firing of coal. We must not, however, lose sight of the future possibility of employing the semi-coke produced by one or other of our coal distillation processes. For the time being it is quite true that the price of such material is generally prohibitive. Recent developments, however, in coal distillation have resulted in the yield of oils of such enhanced value that in the near future the fuel produced will be nothing more than a by-product, and marketed at such a price as to make it the most economical fuel, as it is certainly, owing to its high carbon content, the most suitable for firing in pulverised form.

With regard to the arrangement and disposition of such plants no hard and fast rule can be laid down. Each installation must be governed by local conditions. The final arrangement can only be determined by the expert. We have not concerned ourselves with the cost of such a plant. First cost is a charge against capital. Our concern must rather be what that cost will be per ton of saleable material dealt with over the useful life of a plant. It may, however, be taken that the cost of grinding, including labour and maintenance, is approximately 2s. 6d. per ton.

Correspondence.

[We accept no responsibility for the statements made or the opinions expressed by our correspondents.]

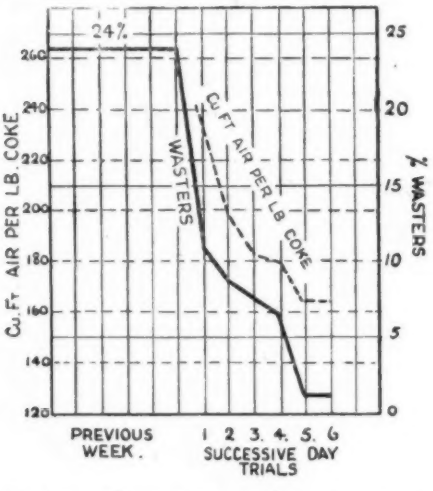
Cupola Conduct and Waster Loss.

To the Editor of THE FOUNDRY TRADE JOURNAL.

SIR,—With regard to the paper read before the Institute of British Foundrymen at the London Convention in June last, entitled, "Some Notes on the Chemistry of the Cupola," by Dr. Thomson and Mr. Becker, I should like to put before your readers some cupola tests carried out by myself to determine the effect of increased amounts of air being employed, especially with reference to its effect on the resulting iron produced.

The cupola on which the tests were made was 50 in. dia. at the tuyeres, of which there were six in two rows, and was working continuously each day for about seven hours. Only one quality of iron was melted, and this consisted of about 70 per cent. mixed pig-irons and 30 per cent. "own" scrap.

One day constituted one test. That is to say, the conditions were constant throughout the whole



of the day. The analysis of the melt was taken every hour, and the same quality of coke used throughout.

The effect of the varied air employed per pound of iron melted was measured by the percentage of wasters in the machine shop.

The main product from the metal consisted of a repetition casting weighing several pounds which had to be machined all over, and the wasters were in the respect of hardness and phosphide segregations. Since several thousands of these castings were made per day, a reasonable measure of the efficiency of the iron was obtained.

The following table shows the main data collected, and the close relationship between wasters and air employed is clearly seen on the curves shown:—

Daily Trial No.	1	2	3	4	5	6
Air per lb. of coke (cub. ft.)	233	197	183	179	164	165
Rejections (per cent.)	11.0	8.7	8.0	6.8	1.3	below 1%
Ratio iron over coke	13.3	12.5	11.5	10.6	10.6	10.5
Time blowing (in hours)	7.3	7.4	7.4	7.4	7.5	7.0
Rate of melting (per hour)	7.67	8.5	8.35	8.0	8.0	7.6
Air per ton of metal (cub. ft.)	39,000	35,000	36,000	38,000	34,500	35,200
Ratio $\frac{\text{diam. cupola}}{\text{tuyere area}}$	2.9	3.24	3.24	3.24	3.24	3.24
Temp. at spout (deg. C.)	1,330	1,340	1,370	1,380	1,390	1,400
Total carbon	3.27	3.44	3.79	3.23	3.09	3.45
Silicon	2.69	2.30	2.15	2.29	2.38	2.42
Phosphorus	1.00	0.97	0.90	1.01	0.093	1.05

The figures indicating the volume of air employed were taken directly from that calculated from the capacity of the blowing multiplied by the revs. of the blower and allowing a percentage of slip, which we found after a long series of tests as applying when compared with a venturimeter.

During the tests it was also observed that iron which had been melted with too great an air supply tended to sink and draw on flat surfaces. This could be overcome by thinning down the gates in order to bring the metal nearer to setting point when it had filled the mould, but the reduction of the air per pound of coke also decreased this trouble *pro rata*.

Yours, etc.,
FERRANTI, LIMITED,
S. E. DAWSON, Foundry Manager.
Hollinwood, Lancashire, July 5, 1926.

Mr. J. H. Partridge's Paper on "Cast Iron for Electrical Machines."

The PRESIDENT raised objection to the use of the word "annealed" throughout the paper, and suggested that the expression "heat treated" should have been used, because in practice annealing was associated with a much longer process than that described in the paper.

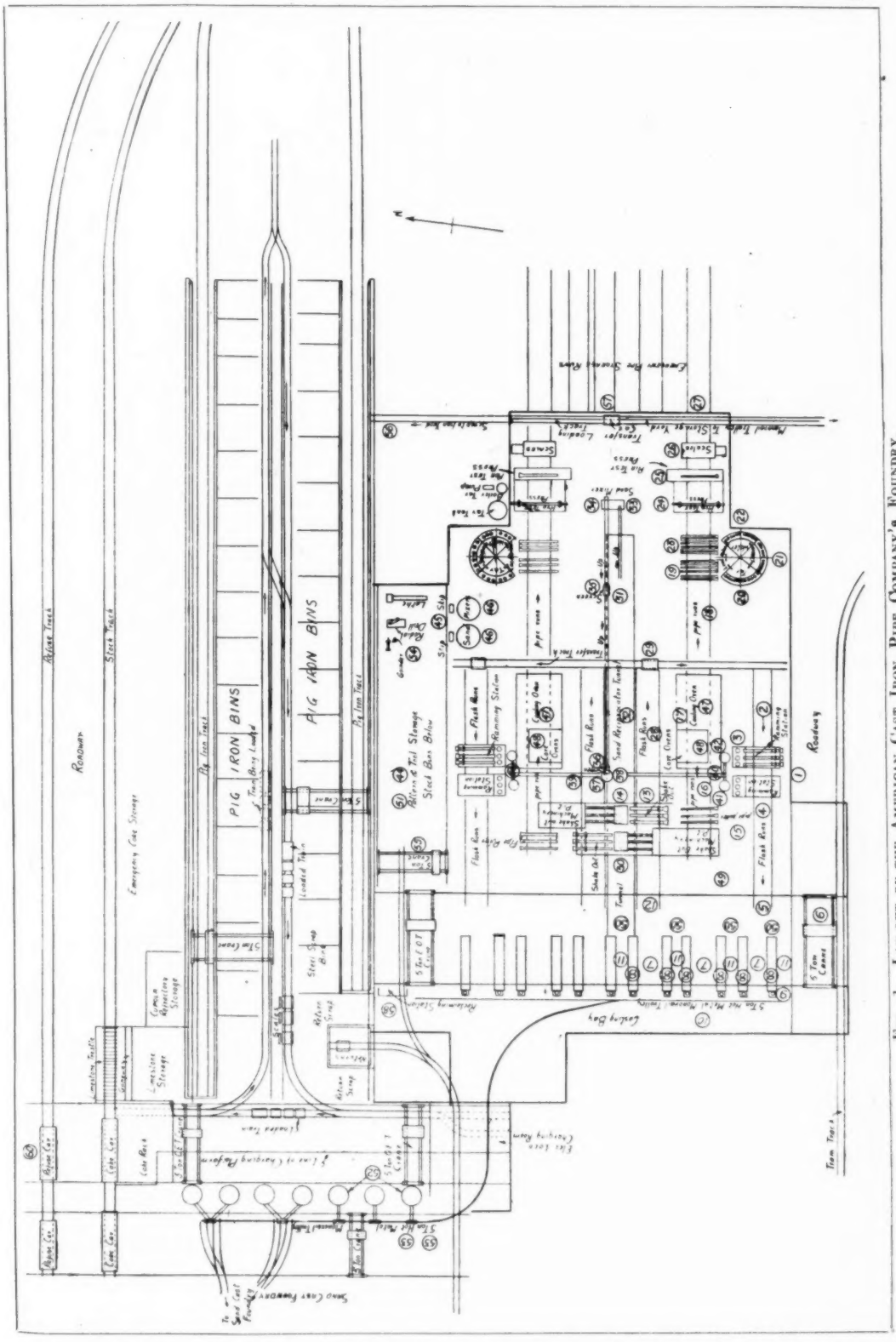
MR. S. E. DAWSON (Messrs. Ferranti, Ltd.), in expressing agreement with the President as to the use of the word "annealing," said that in connection with non-magnetic cast irons the use of the word, in its ordinarily accepted sense, was quite wrong, as they could not be annealed by long heat treatment; as a matter of fact, one did just the reverse, and quenched. With ordinary cast iron the metal was heated up and allowed to cool very slowly over a long period, but since non-magnetic cast iron consisted mainly of austenite which was converted by heat into martensite, the effect of this operation would be to thereby produce some small amount of martensite which would render the material slightly magnetic and hard and it could only be re-converted into austenite and the soft condition by re-heating and quenching. He also pointed out that heat was not the only factor in bringing about this change since excessive mechanical work has the same effect probably due to the formation of strains in the austenite. This was to be seen on the small turnings which were rendered slightly magnetic when non-magnetic cast iron was rough machined, the turnings being slightly converted into martensite so that the permeability might be as high as 10 although the casting itself was not affected. Such a degree of change was, of course, only slight compared with the usual cast iron permeability of 300 or more. These turnings returned to their unity permeability on heating and quenching as described.

Referring to Specimen F in the paper (page 8) and the author's statement that it was made after seeing a notice in the technical Press regarding "Nomag," it was clear from the analyses shown that this specimen was not in accordance with that material, which was 10 per cent. nickel and 5 per cent. manganese, whereas the specimen made by Mr. Partridge contained only 2.04 per cent. manganese. This specimen would not be entirely non-magnetic, because it was necessary to have a minimum content of about 10 per cent. manganese effect made up either in the form of manganese itself or the equivalent of nickel which was half as strong as manganese in this respect. For example, 10 per cent. nickel and 5 per cent. manganese gave a total manganese effect of 10 per cent. (5 per cent. due to the nickel and 5 per cent. due to the manganese). The Specimen F indicated by Mr. Partridge contained a total of only 7.04 per cent. (5 per cent. due to the nickel and 2.04 per cent. due to the manganese itself).

A non-magnetic iron made wholly of manganese would, of course, be extremely hard and unusable, but 10 per cent. nickel and 5 per cent. manganese gives both a non-magnetic and a machinable iron.

Sand-Spun Cast-Iron Pipe Manufacture.

Mono-cast is the trade name of the American Cast Iron Pipe Company for cast-iron pipe made centrifugally in refractory moulds, a subject which can best be dealt with under two heads—(1) raw materials, and (2) equipment for converting the raw materials into a finished product.


PIG IRON BINS
PIG IRON BINS
Roadway
Stock Track
Emergency Coke Storage
Pig Iron Track
Pig Iron Track
Flask Runs
Ramming Station
Core Ovens
Core Ovens
Flask Runs
Flask Runs
Flask Runs
Sand Preparation Plant
Ramming Station
Core Ovens
Core Ovens
Ramming Station
Roadway
Pattern & Tool Storage
Stock Bins Below
Pattern Storage
Pattern Storage
Emergency Storage
Emergency Storage
Coke Cars
Coke Cars
Coke Bins
Pig Iron Track
Pig Iron Track
Pig Iron Track

gauges, recording pyrometers, etc., so that a uniform quality of molten metal is produced throughout the entire heat.

As raw material used in the production of the refractory moulds in which the iron is cast to make pipe, red loam moulding sand coming from the Montgomery, Alabama, district is used as a base, and to this is added a sufficient amount of washed silica sand to produce a moulding sand

a b c

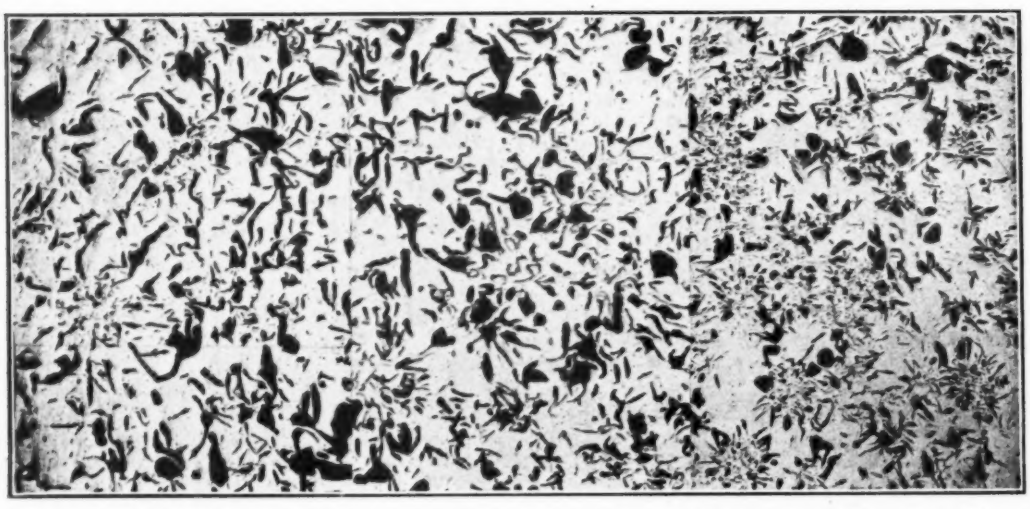


Fig. 2.—Shows Mono-cast Pipe Structure at the Outer Edge (*a*), Middle (*b*), and Inner Edge (*c*).

of the proper specifications. The amount of bond, permeability, moisture, and grain size is constantly checked. It is found that all four elements are of prime importance.

The chief bond of the moulding sand comes from the red loam, but sometimes there is added yellow field clay, fire clay, or glutrine, which is applied to the sand in the form of a thin wash to give additional bond to the sand in the green state.

The sand, when rammed in the flask, is faced with ordinary pipe facing made from nut coke which has been pulverised to the consistency of flour. This is used throughout the Birmingham district as pipe mould facing. This facing as received is in the form of a semi-tempered material, being just sufficiently moist to prevent dusting, and as required is introduced into a mixing machine with water and reduced to a liquid, with the facing material in suspension. It is usually referred to as blacking.

The sand used for making the socket cores, which form the inside of the bell of the pipe, is a very fine-grained washed silica sand, such as is used in making oil cores in the foundry industry for radiator castings. This sand is mixed with linseed oil.

Coal tar is the only other raw material used in connection with this product, and this is bought on a specification governing its content of moisture and free carbon, and is delivered to the plant in tank cars of approximately 10,000 gallons capacity. It is pumped from these tank cars into storage tanks and removed from there to the dipping vats as required.

a b c

Fig. 3.—Shows Micros taken from Similar Positions as Fig. 2.

Plant Used.

The equipment required for the operation of a mono-cast centrifugal pipe foundry consists of the following: Mono-cast pipes are of unit construction, i.e., one pipe to the flask, which are made of cast iron. The flask is machined on all points very accurately to make it possible to do repetition work. It is necessary to ram the sand mould perfectly concentric with the spinning surfaces of the flask.

As shown in the plan of the new plant, there are two 3-way ramming stations indicated at

position (1). The empty flasks come down the run as indicated at (2), and are received on a tilting table in the run, which delivers them into the vertical position on the ramming stations as shown at (3). The flasks are handled three at a time, and these two ramming stations are used to alternate the work, so that while they are ramming on one station they are completing the rest of the work and making the change on the other station.

Once the flasks are in the vertical position and properly located on the ramming tools, the three patterns are lowered into the flasks. These patterns are handled from above by a stationary pattern hoist.

The pneumatic ramming machines are then moved into position by mechanical means from above and lowered into the individual flasks. The sand delivery-chutes are placed into position and the ramming operation proceeds throughout the length of the mould, which is about 16 ft. long. The time consumed in ramming is about 1½ minutes.

MR. W. D. MOORE,

President of the American Cast Iron Pipe Company, and the Inventor of the Centrifugal Casting Process, by which Mono-cast Pipes are Made.

The patterns are drawn, three at a time, from the moulds, the moulds are lifted off the ramming stools by a hydraulic lift, and the blacking is applied to the face of the moulds while in a vertical position. They are then returned to the horizontal position by the tilting table and are ready to move forward on the flask run, as indicated at (4). The flasks then proceed to (5), where they are picked up by an overhead crane (6) and delivered to the casting machines at (7). In this operation the flasks are handled two at a time by a special device attached to the crane.

The top half of the Mono-cast pipe-casting machine, as shown at (8), is elevated to sufficient height to allow the flask to roll in sidewise. The machine is then closed, the motor is attached to the flask by a quickly detachable clutch, the proper amount of iron is placed in the pouring ladle, as shown at (9), from large ladle on mono-rail trolley (10), the machine is then inclined to the proper angle with reference to the horizontal, and the pouring operation proceeds. Immediately the metal is poured in the mould it is set spinning, and the iron is placed on the wall and held there in the form of a tube until it is sufficiently set to retain its shape, when the machine is shut down.

The mould, with a finished pipe in it, is rolled on through the machine and takes the position shown at (11). From this station it is moved to (12), where the end trimmings are removed from the flask, the socket sand removed from the bell end of the pipe. All of this takes place within 10 minutes, including the casting and spinning operation.

The flask, with the sand and pipe in it, now passes to the stripping machine as shown at (13), which is a 3-way machine built on a rather abrupt incline. The flasks are placed on a tilting table and tilted to the incline, in which position they are held while the sand is being removed from the mould. The flasks, with the pipe in them, are returned to the horizontal position by the tilting table, and the pipe puller (15) removes the pipe from the flasks three at a time and deposits them on the run at (16). In this run there is a conveyor which immediately conveys the pipe into a cooling oven at (17).

This cooling oven is equipped with a slow-moving conveyor which gradually rolls the pipe through the oven, where it is kept under temperature control for approximately forty minutes, and until it has reduced in temperature to at least 260 deg. C., at which time it is ready to be removed from the cooling oven and enter the cleaning department as shown at (18).

When the pipe is cleaned it passes to station (19), where it is picked up by a small hoist, and passes to station (20). Here it is lowered into a bath of tar and is held in this bath a sufficient length of time to take an adequate coating. The bath itself is under temperature and chemical control. The pipes then pass to (21), where they are permitted to drain free of surplus tar and then pass to (22), where they continue to cool. They then pass to station (23), where they are lowered to the pipe run again and proceed to the hydraulic testing press (24). Gas pipes are not coated, but after being tested in press (24) they pass to press (25), where they may be given an air test of 25 lbs. air pressure under water. From here they pass to station (26), where they are weighed and the individual weight marked on the outside and inside of each pipe. From here they pass to (27), where they are picked up by a mono-rail hoist or truck and distributed on the loading yard as a finished product.

From station (13) the empty flasks proceed down the run to (28) and then to transfer car (29), and are taken across, as shown by the arrow, to flask run (2), and then proceed through the ramming station again in their regular turn. In this shop are two units which operate entirely independent of each other, except that they have the same sand-handling and preparing machinery, and the same source of iron supply.

Sand Reclamation.

The sand tempering and regenerating starts at station (14), which is the dry storage bin where the sand is accumulated as it is removed from the flasks during the stripping operation.

Number (30) indicates a shakeout sand storage bin for the opposite half of the shop, and serves in the same way as 14. These are both situated on the centre line of the shop.

Underneath these bins there is a reciprocating sand conveyor operating from the bins to (31). This conveyor takes the sand from the bins (14) and (30) at a predetermined rate, which is controlled by slide valves and the stroke of the reciprocator. As the sand comes from these bins into the reciprocator it is almost, if not entirely, free from moisture, and at a temperature of approximately 125 deg. F. As it is moved along by the reciprocator between stations (14) and (32) clear water is added, which is the first addition to bring it back to moulding temper.

At station (32) is the make-up sand in a bin which is equipped with an automatic feeding device operated by the stroke of the reciprocating conveyor. This feed is adjustable so that with each stroke of the conveyor there is introduced a definite quantity of make-up sand. In this way a uniform distribution of the new make-up sand into the total body of sand is effected. As the

sand continues to move from (32) to (31) by means of the conveyor, it is thoroughly mixed and additional water is added if required.

At (31) the sand is delivered by the reciprocating conveyor to a belt conveyor which is running at an angle of about 30 deg., and which elevates the sand from the basement of the shop to a point above the working floor level and delivers it into a duplex paddle mixer at (33). In passing through this mixer the sand is thoroughly mulled, and if any additional water, or clay wash, or any other material is to be added it is added at this station, so that as the sand leaves this mixer there are no more additions to be made, except the final addition of water to make up any error in moisture that may be found later.

The sand is delivered from the end of the paddle mixer at (34) on to a belt conveyor which is operating at an angle of approximately 30 deg. This belt elevates the sand to station (35), where it is discharged off the end of the belt on to a vibrating screen, which mixes and aerates the sand and delivers it on to another belt conveyor which is operating at an angle of approximately 30 deg., and the lower end of this belt conveyor is approximately 6 ft. above the shop floor level. This belt works from (35) to (36), and on account of the inclination, station (36) is well up into the third floor of the shop.

As the sand is carried from (35) to (36), test samples are taken and a check is made for moisture, permeability and bond. In addition to this,

FIG. 4.—TRANSVERSE TESTING OF PIPES.

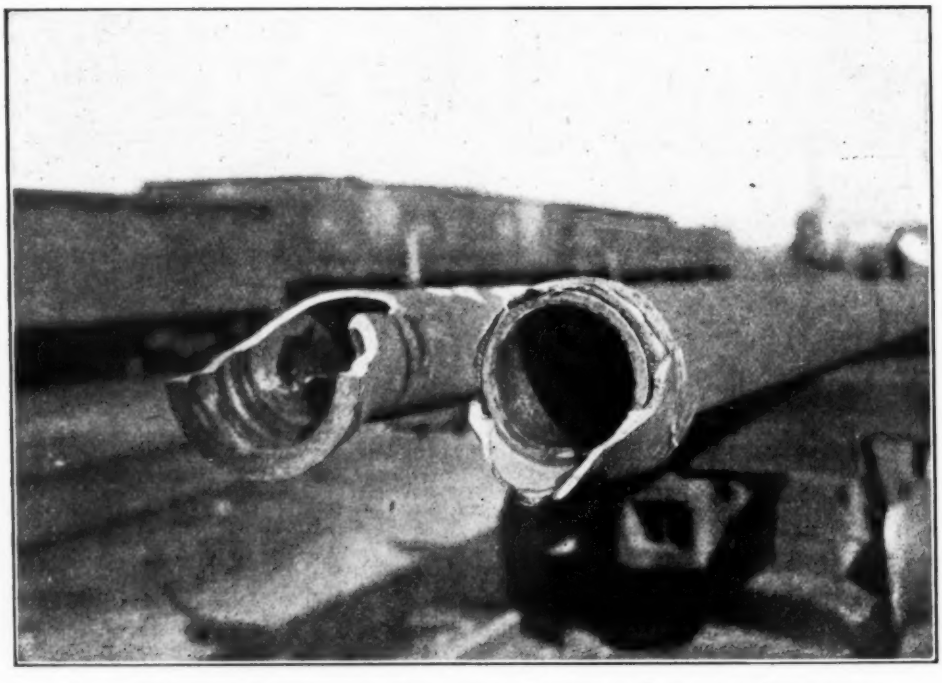


FIG. 5.—SHOWING FRACTURE OF PIPES AFTER TRANSVERSE LOADING TO DESTRUCTION.

the screen test is made from time to time to keep the grain size under control.

Along this belt conveyor there is an equipment for adding water to the sand should the test indicate the necessity. In actual practice the sand is run a little on the dry side coming through the mixers (33) and (34) to avoid ever having it too wet as it comes on to the belt at (35).

As the sand arrives at (36) it passes on to another vibrating screen which further mixes and aerates it, and breaks up any accumulation of moisture as a result of applying water to it on the belt. The sand then drops into a circular revolving bin (37), where there is a nominal storage of tempered sand.

The bottom of this bin is equipped with an automatic feeding device so sand can be delivered to cross belts (38) and (39) simultaneously or separately. From station (38) to (40) there is an inclined belt conveyor elevating the sand from the bottom of bin (37) up into a chute which delivers it to bins (41) and (42). As the sand travels from (38) to (40) on the belt it is again sampled and tests run for moisture. This belt is used in connection with the regular moulding sand and the other is the oil sand mixture used for making the socket cores.

An electric storage-battery lift-truck is used for transporting the tempered sand from (46) to (32), where the make-up sand bin is located. The same truck is used for delivering the oil sand mixture from (46) to (47), which is on the second floor immediately over the cooling ovens, where the socket cores are made up ready for entering the drying ovens (48). These core ovens are built in direct connection with the cooling ovens and utilise the waste heat from the hot pipe as they pass through the cooling ovens. These ovens are also equipped with gas burners, so they can be operated independently of the cooling ovens when necessary.

When the socket cores are dried they are removed from the ovens with the lift truck and transported by way of a platform to (49), where there is an elevator which lowers the truck to the first floor, and the rack of cores is delivered to (50), where they are used in the moulds. When the racks are empty they are returned to the

FIG. 6.—THESE PIPES HAVE BEEN SPLIT ENDWISE FOR THE TESTING FOR SOUNDNESS AND UNIFORMITY OF SECTION.

also equipped with water facilities, so we can add moisture if found necessary.

Sand bins (41) and (42) are of the revolving type with automatic feed at the bottom. These bins are located immediately over the ramming station as shown in the plan, and it is from these bins that the rammers take the sand and deliver it into the flasks as required during the ramming operation. The construction from (39) to (43) inclusive is a duplication of the construction from (38) to (40), and serves the opposite ramming station.

The raw materials, such as sand, facing, clay, etc., required in the operation of this plant are stored in the basement of the shop, as noted at (44). At (45) there is a pair of vertical skip hoists which handle a half-yard bucket from the basement floor of the building up through the first floor and delivers their charge into the Simpson mixing mills on the second floor, as shown at (46).

The raw materials are taken from the storage bins in the basement and mixed in predetermined proportions in these skip hoist buckets, and when the operator running the mixers is ready he operates the hoists and delivers the charges into the mills, where it is thoroughly mulled, and receives the proper amount of moisture to bring it to temper. It is necessary to maintain two mixtures of sand. One is for the make-up sand second floor by the lift truck and elevator. All deliveries of materials are accomplished by means of the lift truck.

Facing the Moulds.

The facing, which is used on the moulds to provide a parting between the sand and the iron during the casting, and to cause the sand to peel off the casting, leaving a clean, smooth surface, is stored in the basement at (51). Here there is a mixing machine, similar to a concrete mixer, in which the facing is mixed with water and clay, with the addition of any other materials necessary to make the facing of proper consistency, such as glutrin, syrup or similar binders. The liquid facing is discharged from the mixer into a container from which it is picked up by means of a centrifugal pump and is circulated through a piping system with delivery at the ramming station, where it is always available for facing the moulds. The facing operation is accomplished by a special dasher rigging which is inserted in the mould and through which a predetermined quantity of facing is poured. The facing spreads itself over the surface of the mould and drains into a receptacle at the lower end of the mould. The facing liquid is kept in constant agitation so as to prevent settling of the solids.

XUM

Melting Plant.

The cupolas (52) are equipped with tilting spouts, and one ladle is always maintained at the cupolas while the other ladle is being poured. Three ladles are in service at all times. An I-beam trolley system, as shown on the plan, runs along in front of the cupolas and then into the casting bay of the plant, where it runs in front of the twelve Mono-cast pipe machines. On this trolley system are two 5-ton mono-rail hoists.

The ladles of hot metal, holding about four tons, are picked up at the cupola station and carried into the Mono-cast pipe plant by means of the mono-rail hoist, and the pouring ladles on the individual machines are filled with the proper amount of metal for the pipe being cast. There is sufficient metal remaining in the large ladle to repeat the operation, at which time the large ladle is returned to the cupola for refilling. During the intermission a ladle has been filled at the cupola, so that the operator sets down one ladle and picks up another and returns to the casting machines. Each pouring trolley takes care of six Mono-cast pipe machines, and they work independently of each other, although either of them can charge any of the casting machines when necessary.

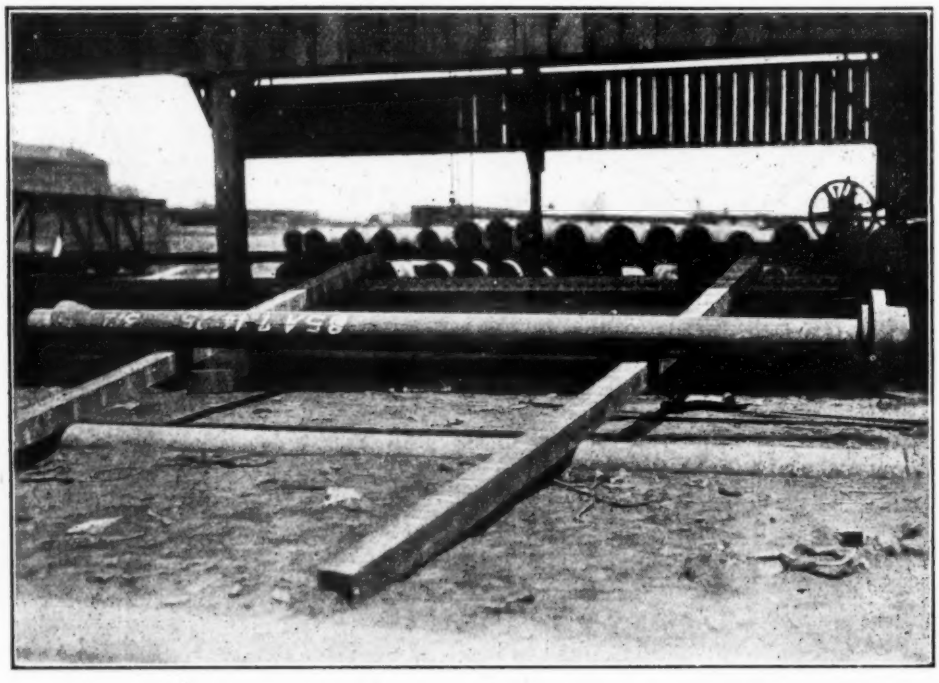


FIG. 7.—HYDRAULIC TESTING TO DESTRUCTION OF SAND-SPUN PIPES.

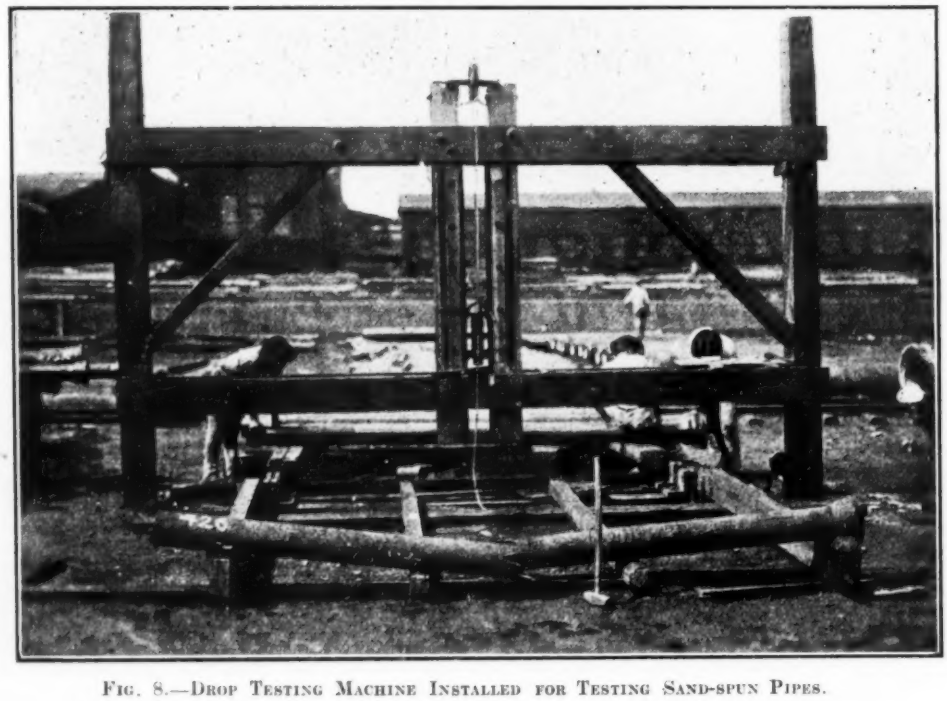


FIG. 8.—DROP TESTING MACHINE INSTALLED FOR TESTING SAND-SPUN PIPES.

Chemical and Physical Control.

Starting at the cupola spout there is an automatic recording pyrometer to take the temperature of the iron as it flows from the cupola to the ladle. This record also shows the number of

taps made from the cupola during the operation, and the duration of each tap required to fill the ladle. As the iron enters the casting bay and is poured into the individual pouring ladles the temperature in each ladle of iron is read with an optical pyrometer and is reduced to a predetermined point before pouring.

Additionally, standard 1 in. by 2 in. by 28 in. test bars are poured, one pair of bars from each three hours, or fraction thereof, operation of the cupola. These bars are broken in a standard recording transverse testing machine, and after breaking drillings are taken from the bars and chemical analyses are made covering all essential elements, such as silicon, sulphur, manganese, phosphorus and total carbon.

Each car load of iron coming into the plant is sampled and an analysis made before the car is placed for unloading, and the iron is used according to this analysis in making up the mixture. The coke for melting the iron is tested in the laboratory for ash and volatile matter. Recording pressure gauges are maintained on each cupola. A screen test is run on each truck load of sand. A viscosity test is made on each consignment of tar. Recording thermometers are maintained on the pipe cooling ovens, and the socket core ovens. A complete set of modern sand testing instruments are maintained, and one man per shift devotes all of his time to the testing of the moulding sand.

Recording thermometers are maintained on the tar dips and the temperature of this coating material is under automatic control. The testing of the tar bath every three hours is directed from the laboratory. There is a recording instrument connected to the hydraulic press for recording the actual pressure applied to each individual pipe as well as the time the pipe remains under pressure. The same type of instrument is used for recording the pressure of air applied to pipe. The scale on which the pipe is weighed has an automatic beam attachment which shows the actual weight of the pipe without any shifting of weights or manipulating of beams.

At station (54) on the first floor there are standard machine tools. This equipment is served by a 5-ton overhead 3-motor crane, as shown at (55). The floor space between (54) and (55) is used for storage of the spare tools and equipment necessary to maintain and operate the plant.

The runs, as shown at (57) are used for emergency and temporary purposes for segregation of pipe coming out of the plant before it moves to the loading yard. At station (58) there is a reclaiming unit which handles all of the refuse from the plant.

The power for the operation of this plant is as follow:—

Water at 500 lbs. for manipulating the hydraulic cylinders and testing units; air at 90 lbs. for the manipulation of all air rammers and other compressed air equipment; steam for bringing the tar up to temperature in order to facilitate removal from tank cars, from storage tanks into dipping tanks and for maintaining temperature in tar dips; by-product gas of approximately 350 B.T.U. for all necessary heating about the cooling ovens and core ovens; electric D.C. current at 220 volts on all electric cranes, etc.; and electric A.C. current at 440 volts, 3 phase, 60 cycle on all motors of constant speed.

This plant is capable of being operated 24 hours per day, and has a nominal capacity of 50,000 ft. of Mono-cast pipe per day with a range of sizes from 4 in. to 12 in. inclusive, with the ability to put any two machines in the shop on any given size.

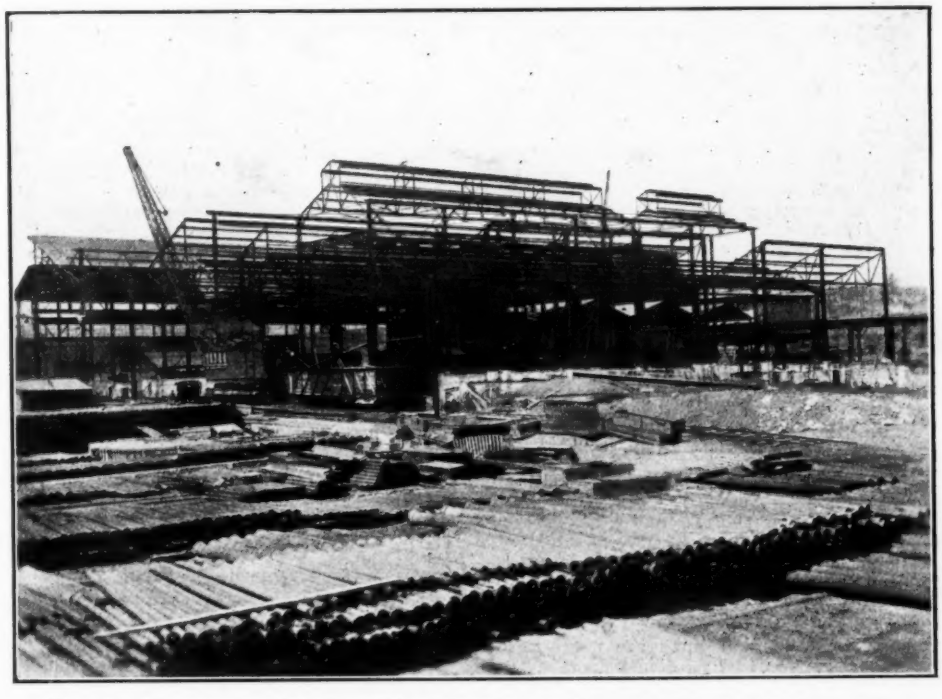


FIG. 9.—CONSTRUCTION WORK ON NEW FOUNDRY AT BIRMINGHAM, ALABAMA, FOR THE MAKING OF CENTRIFUGALLY CAST IRON PIPES.

The Mono-cast pipe machines and all equipment connected with them are adjustable and interchangeable, so far as pipe sizes are concerned, and any machine can be adjusted to handle any size pipe from 4 in. to 12 in. This same rule applies through the shakeout and ramming stations.

A Mono-cast pipe is a very striking casting in appearance. Both its outside and inside surface are clean and smooth, the bead and bell are true to the pattern, and are claimed to be entirely sound and are obviously free from gates and fins. The sections are uniform both circumferentially and longitudinally, and the pipes are round and straight. The metal shows a grey iron fracture with a fine, close grain on the outside of the pipe, changing gradually to a normal medium grain on the inside. The microscope shows a fine skin on the outside; there the graphite immediately forms in fine whorls, the size of which increase slowly until the inner surface is reached. Especially noticeable is the freedom of all sections of the pipe from shrinkage cavities, gas pockets, blow holes and solid inclusions of all kinds. There are no surface pittings on the outside or

dross inclusions on the inside, so that all of the wall of the pipe functions as a sound grey-iron casting.

Tests on Mono-cast pipe are claimed to show 40 per cent. better resistance to hydrostatic pressure than the ordinary sand cast, 20 per cent. greater value in cross bending, and 25 per cent. greater value in withstanding shock.

The new Mono-cast pipe process is extremely flexible in its application. The company calculates that the direct costs in single shift will be very little different from costs in continuous operation. As any pair of machines can be operated on any size, and it only takes but a short time to change over, the shop can readily be arranged to take care of any trend of the market towards any one or two sizes.

From the labourer's standpoint the Mono-cast process is a great relief. The new shop is cooler in summer and warmer in winter and much cleaner. Practically no hand labour is left, as machines do everything and men are needed only as machine operators, instrumemt men, etc. As the excellence of the product depends rather on the efficient maintenance of the machines than any other factor, it is much more easily maintained than where it depends on the skill of a moulder.

The American Cast Iron Pipe Company insist that there is a demand from the public for a different product. Where the permanence of cast iron is desired for a cost comparable to that of a substitute—where the use of a smaller safety factory is permissible—Mono-cast pipe is a really suitable material. In view of the excellent physical properties of Mono-cast pipe this moderate reduction in wall thickness is justified under the usual service conditions. This gives a corresponding reduction in weight with the attendant saving in iron and freight costs.

Preparations are now under way for the production of Mono-cast pipe in the larger sizes. The flexibility of the Mono-cast pipe shop is valuable in this connection, as the demand is uncertain for any one size above 12 in.

Standardisation in Pattern Shops.

By J. M.

Is it possible to standardise pattern equipment, and if so would there be any advantages gained by doing so? It appears to the writer, speaking from a long and intimate experience in pattern shops and foundries, that there are many more pressing problems awaiting solution than this. In the case of standard work it is good practice to distinguish between machined surfaces, core prints and black surfaces, but, even when a pattern thus marked goes to a strange foundry, there is seldom any difficulty in deciding what the various colours stand for. Were the suggestions of the American committee, which is reporting to the International Congress in Detroit, to be adopted in this country, pattern costs would be considerably increased.

Repetition work is not so general in this country that it is necessary to adopt standard sizes for pattern plates, for instance. In most cases only one foundry handles a pattern plate. For certain classes of work it might suit engineers to be able without inconvenience to transfer plates from one foundry to another, but when there is a big run, it is not a serious matter to make the necessary alterations or adaptations. To be logical about standardising pattern equipment it would be necessary to adopt one type of moulding machine for general use which, of course, could not be done.

The writer cannot see what gain there would be in adopting standard fillet sizes, because fillets must vary even on wall thicknesses that are the same, being modified according to the design of the casting. In theory standardised fillet sizes appear possible, but theory so often fails in the workshop.

Many styles of letters and figures are used for marking patterns made in iron, brass and white metal; shops adopt the metal and style of lettering that they consider is best, and what gain would come from standardisation it is difficult to see.

In regard to shellacs and paint ingredients used in pattern making a volume could be written. There is the recognised standard shellac varnish mixture which consists of shellac melted in methylated spirit, some pigment being added to give a colour if such is desired; this mixture is unsurpassed.

Catalogues Received.

Moulding Machines and Foundry Equipment.—The Britannia Foundry Company, Limited, of Coventry, have sent us a 56-page, well-illustrated pamphlet printed on art paper, which is devoted in the main to machine moulding and core ovens. We were particularly struck with a foreword, the realisation of which would do much to ensure success of machine moulding. This foreword states: "A moulding machine will only do two things—(1) ram the mould, and (2) extract the pattern without damaging the mould. The pattern-plate maker and the foreman moulder are responsible for the rest."

The "Introduction" to the catalogue is splendidly thought out, and is a common-sense appeal for the common-sense utilisation of moulding machines in general. Three pages are given over to the jar ram and shipping pattern machines, the five sizes specified covering a range from 5-cwt. lift with a 6-in. draw up to 30 cwt. with 1 ft. 3 in. draw. A range of six sizes of turn-over jar ram and a series of four plain jar-ram machines complete the section devoted to this particular method of moulding. The "Coventry" pneumatic jolt squeeze moulding machine is one of the most interesting of the machines described. It is made in one size only, taking as a maximum either 16 in. square or 20 in. by 14 in. moulding box. Sandwiched in between this and a section devoted to hand-operated machines are descriptions of air compressors and a pneumatic sand sifter, a feature in the make-up of the catalogue which seems illogical. The balance of the catalogue treats of a complete pattern-plate making apparatus; sand mixers of the double-cone variety; oil sand mixer; git cutters, whilst ten or a dozen pages are devoted to core ovens.

Machinery for Rubber Plantations.—Messrs. David Bridge & Company, Limited, have sent us a 36-page beautifully illustrated brochure describing the plant which they as founders and engineers make for the rubber plantations.

Sand Blast Apparatus.—Messrs. Tilghman's Patent Sand Blast Company, Limited, Broadheath, near Manchester, have sent us a 58-page catalogue, produced on art paper and doubly jacketed in imitation leather. It is splendidly illustrated, and covers the whole field of sand blasting. Some five pages are devoted to an historical survey of the sand-blast process.

The catalogue opens up with a description of the automatic sand and shot elevator, mixer and dust separator, following on with sand-blast room plant, sand-blast tumbling barrels, rotary tables and working chambers, the working of which is performed by an operator outside the chamber. A cabinet is described and illustrated which is fitted with an injection type jet for use with high pressure air. Portable machines are next dealt with. The catalogue then resumes interest for the foundryman on page 31, where equipment for the operator is described. Several pages are devoted to air compressors of various types. We found the abrasives for use with sand-blast plants extremely interesting and well produced. The brochure finishes with an imposing list of users. It is a catalogue which will be prized by most recipients, and it is, we understand, available for our readers.

THE SENTINEL WAGON WORKS, LIMITED, have orders for six 80 h.p., 2 ft. gauge, locomotives for the India Stores Department; one 20 ton, 100 h.p., 5 ft. 3 in. gauge locomotive, for the Adelaide Gas Works, South Australia; and one 20 ton, 200 h.p., 3 ft. 6in. gauge double-engined locomotive for the Spring Mines, Limited, South Africa.

Improving Cast Iron as Shown by Tests.*

By J. R. Hyde.

INTRODUCTION.

The subject of the improvement in cast iron has always been as interesting to practical foundrymen as the improvement in cupolas, and it is proposed to describe experiments made during a fairly extensive period in a general endeavour to produce improved and regular commercial cast iron. The word "Commercial" cast iron will frequently occur in this Paper, as it is necessary to distinguish it from laboratory experiments, and it should be understood that all these experiments have been carried out on at least 20 cwts. and upwards of material, and that the results obtained are averaged from tests on these commercial weights.

Commencing in 1905, some 20 years ago, with his first contract where tests were specified, the author rigged up a testing machine from a 2-ton Avery weighing machine, and commenced by using Derbyshire No. 3 foundry pig-iron, and the standard West Coast hematites of that date.

The Derbyshire brands of pig-iron used were:—Staveley, Sheepbridge, Clay Cross and Renishaw, and the West Coast hematites were Barrow, Ulverston, Carnforth and Millom. Scrap was broken machinery-quality, of generally thick section material, lighter types of scrap being avoided.

A modern Olsen testing machine of 15 tons capacity was installed in 1912. The first improvement was to standardise the foundry practice, so that liquid cast iron could be reproduced under similar conditions throughout the whole of one week. The items over which control was sought were as set out in the following list of commercial constants:—(1) Pig iron, *i.e.*, commercially similar irons mixed; (2) coke and flux; (3) cupola routine; (4) cupola charging; (5) electric A.C. motor direct coupled to fan; (6) blast; (7) melt and mix charge; (8) casting temperature; (9) mould and standard gate on standard bars; (10) "as cast" or machined bars; and (11) testing machines.

Pig-Iron.

In order to mix the pig-iron as effectively as possible, an endeavour was made to secure one cast of pig-iron from the blast furnace—that is to say, all which was classified as No. 3 from a tap. As is well known, the grading of iron from a tap varies, but in this manner about 18 tons of commercially graded No. 3 irons are obtained. These various pig-irons were stacked by an electromagnet in layers in a manner somewhat similar to that described by Dr. Moldenke at his lecture in Sheffield, and by taking each day's supply of pig-iron vertically from the end of the stack, a reasonable mixture is obtained. The scrap was treated in a similar manner.

Coke.

It was found that the quality or brand of coke used in melting had a marked influence on tests, and apparently that this may be due to so many reasons that they preclude discussion, but form, in a Paper of this character, a very practical subject for a student of the Cast Iron Research Association, assisted by some practical foundrymen, to investigate. The practical course adopted was to melt for one month exclusively on one coke, changing over entirely to another coke for the following month, and compare the records from the foundry scrap heap, melting sheet and output. A selection on this basis has been known to yield a 50 per cent. variation in the value received in good castings per 20s. expended on coke. A standard charge of 14 cwts. of iron on 1 cwt. of coke has been now adopted.

After the monthly trial it is desirable to carry on extended trials over three months, as very useful information will be forthcoming. The same flux, such as Buxton limestone or Anston limestone should be maintained throughout all tests and experiments.

Cupola Routine.

It is advisable to standardise the working conditions of the cupola particularly as to the time at which the bed is made up, the first charge put on, and the period which elapses before putting on the blast. A tall stack to the cupola is of distinct assistance in creating a natural draught and overcoming the bad days when the wind seems to be in the wrong quarter for regular cupola routine.

Cupola Charging.

The cupola should be charged in a regular manner, and attempts should be made to lay the pig-iron on the coke evenly as a pavement. The steel scrap is charged next and the machinery scrap last.

Electric A. C. Fan Direct-Coupled.

It is desirable to call the practical foundryman's attention to the fact that with an alternating current electric motor coupled direct to a fan it provides a constant speed with the minimum of trouble, and from this mechanical device one is pretty well assured of the same amount of blast under similar conditions on all occasions, and it eliminates any discussion relating to the fan and belt.

Blast.

It is the author's practice to put on full blast from the beginning and maintain it continuously.

Melt and Mix Charge.

For regular quality of iron it is advisable to run a considerable quantity, say equal to one charge, into a ladle or fore hearth, and then either take the ladleful bodily to the work, or pour out into convenient quantities.

Casting Temperatures.

It has been recognised ever since the careful work of Hailstone that the casting temperature has a very marked bearing upon the strength of cast iron when under test. His experimental figures show that cast iron, cast at a temperature of 1,428 deg. C., may have a tensile strength of 10 tons, and the same iron cast from the same ladle at 1,348 deg. C., will only have a tensile strength of 9.6 tons, and at 1,264 deg. C. a tensile strength of only 5.2 tons. It is obviously desirable and highly important, from a testing standpoint, to melt the iron as hot as possible, so that we have a wide range of useful casting temperatures, that is, from 1,360 deg. C. upwards, at which to pour the castings.

Mould and Standard Gate.

In the preparation of test pieces, a standard green-sand mould was used, and the gate was fastened on to the pattern so as to get definitely comparative rates of running.

"As Cast" or Machined Bars.

As the general practice at present in this country is to test the bars in the "as cast" condition, all the figures given in this Paper, for transverse tests, are on the "as cast" bars. The author prefers, however, to use a machined bar for the transverse test, as much more satisfactory deflections can be obtained without any loss in the load. The tensile test pieces were all machined.

Testing a Machine.

The later tests were all made on a 15-ton Olsen testing machine with fixed hard steel supports: but it is being recognised by engineers that some rolling centre is desirable when testing cast iron in transverse position, owing to the pull introduced on the bottom edge, and a cup-and-ball device is incorporated.

Varying the Cupola Mixture.

The first were run on charges of all pig, then a charge of all scrap, then mixtures of half and

* A Paper read before the Sheffield Branch of the Institute of British Foundrymen, Commander Jackson presiding.

half. It may be thought that it was a somewhat bold move to run a charge on all scrap; but under proper melting conditions the quality of the iron obtained was not too hard for general machining purposes, and the results on the testing machine were distinctly interesting, being very little below pig-iron and often equal.

As a comparison for excellence, there was melted and tested a portion of the old Norton Hammer water wheel, upon which site one of the author's foundries was built, as in the pulling out of some of the old foundations about 2½ tons of cast iron was unearthed. This apparently was the cast-iron framework of a water wheel made about 1780.

When one studies the tests and properties of cold-blast iron one is forced to the conclusion that if that iron were readily and cheaply available to-day there would be available the iron for which foundrymen are all seeking, but the commercial side of the matter enters into business, and this insists upon cold-blast quality in an iron made and sold at hot-blast price.

About this period there was an invasion from America of literature on the subject of semi-steel, and it was decided to incorporate these in the scope of the experiments. The addition of steel scrap was in the form of files and spring-end croppings, and with a 10 to 15 per cent. addition of steel a distinct improvement was observed, as is shown in Test No. 7.

On considering the question of analysis, one should confine his ideas of percentage of impurities strictly to cast iron, and probably the first place

TABLE I.—*Transverse and tensile tests from various mixtures.*

No.	Mixture.	Transverse in cwts. 2×1 on 36 in. C.*	Deflection in ins.	Average Tensile tons.	Average Crushing tons.	Per cent.	Per cent.
1	All No. 3 pig	27.0	0.35	9.3	42.0	1.4	3.4 to 3.7
2	All No. 4 pig	28.5	0.30	9.5	47.0	1.6	3.4 to 3.6
3	All mach. scrap	27.5	0.32	10.0	45.0	1.5	3.5
4	Half each 1 and 3..	28.5	0.36	11.0	46.0	1.5	3.5 to 3.6
5	Cold blast	36.0	0.42	14.0	52.0	0.8	3.4
6	Mixed Hem. Pigs	28.0	0.38	11.5	44.0	0.06	3.6
7	Pig 2, scrap 2, solid steel scrap 1	31.0	0.38	12.0	48.0	1.25	3.3 to 3.4
8	Pig 2, scrap 2, liquid steel 1	37.0	0.42	—	—	1.2	2.9 to 3.0

* On 2×1 in bars at 36 in. centres.

of decimals is sufficiently accurate for practical purposes, except in the case of elements of sulphur and phosphorus. Thus the total carbon in the Derbyshire pig-iron is found to be round about 3.4 to 3.6 per cent., in the cold-blast 3.3 per cent., and the steely mixture 3.2 per cent. The phosphorus in the Derbyshire pigs is 1.4 to 1.5 per cent., in the cold-blast 0.7 per cent., and the hematites 0.06 per cent.

In 1912 the author's attention was directed toward further toughening cast iron in order to withstand a drop test. Cold-blast iron, both alone and mixed, was tried and failed, and the next inclination was to make steel.

At this time the Stock oil-fired converter had been introduced into this country, and the compactness of the plant for small quantities of steel was distinctly interesting. Oil, however, was a very much more expensive fuel than coke, and consequently a small combined cupola and converter was built. This formed a very useful furnace for experimenting with steely mixtures, although as a commercial producer of steel it was valueless.

Description of Converter.

In order to melt and blow small weights, say, approximately 8 cwts. of hematite pig-iron, a small cupola cut diagonally about one-third up the height, with the top half held from the stage and the bottom half free to turn on hollow trunnions, was erected. Air for melting the charge as a cupola, and also for blowing for steel-making purposes, was taken through one of the hollow trunnions, with suitable blast-gauges for regulation. Both halves were made lineable and the joint patched, and then the cupola charged and fired in the ordinary way. After melting the required 8 cwts. of hematite, the peculiar shape of the bottom portion allows it to be tilted forward, the unused coke is raked off, and it is then tilted back again into its original position and the joint caulked with ganister. High-pressure air is then admitted through the converting tuyeres at the back, and in order to vary the angle, if necessary, the whole cupola could be swung from the trunnions on an arc built on the cupola stage. When the conversion was completed, the steel was poured from the bottom or well of the converter by tilting from the joint. For steel-making purposes the results were erratic, due to cokes sticking to the lining in various parts and upsetting the flame.

Up to 25 per cent. of the blown metal was added to the commercial cast iron, made from the Derbyshire pig-iron and scrap, but it had such a hardening effect due to the dilution of the element silicon that thin castings had to be annealed before they could be drilled or machined.

The transverse tests of hematite pig mixture in the "as cast" condition were, however, remarkably high, being 37 cwts., and after annealing for six hours and slow cooling, 45 cwts. was regularly obtained with a deflection of 0.52 in., and some of the bars showed a distinct permanent set, proving that it was evidently on the borders of a ductile material.

The expense of annealing rather detracted from the commercial value of this semi-steel. However, a considerable quantity of this material was made, as it is obvious that if the steel was not quite fully blown and even 1 per cent. of carbon left in, it did not affect the resultant semi-steel castings detrimentally, but, of course, if steel was cast from the furnace with 1 per cent. of carbon into castings, they were useless.

With the oil-melting idea still in mind, town gas was used during the melting process, and the coke supplemented by simply running a ¼-in. gas-pipe into the tuyere and allowing the gas mixed with the air to enter and burn. The author has since thought of using this gas jet to clear blackened tuyeres in ordinary cupola practice, and hopes some day to give the result of this experiment, although the high sulphur-content of the gas does not make it an ideal fuel for melting high-quality cast iron.

It is somewhat remarkable that whilst the author was adding this blown steel to cast iron, another gentleman was experimenting along the same lines in the Middlesbrough district, and took out a patent for the process. This fact, combined with the high cost, and the absence of any measurable ductility in the semi-steel castings, caused it to be shelved, and it was decided to meet the specification by true steel castings.

An electric furnace was therefore installed, and a few experiments were carried out on cast iron melted in this furnace. Steel was used as additions to cast iron, and it was found that the results were pretty much the same as with side-blown converter steel, except that the expense was greater, and therefore the process was ruled out as not being commercial.

Electric Furnace Melted Cast-Iron.

At the Blackpool meeting of the Institution of British Foundrymen an American Paper, by Mr. Elliot, was given, claiming improved qualities in cast iron melted from an electric furnace, due to the reduction in the percentage of sulphur-content. Several speakers, recalling Hailstone's experiments, were definitely of opinion that the high

casting temperature or super-heating which is possible with the electric furnaces was responsible for this improvement. It is now established that some of the improved processes for cast iron today are considerably assisted by the use of high casting temperature.

In melting with the arc type of electric furnace it was found that between 850 and 900 electric units per ton were used to provide cast iron at a temperature round about 1,460 deg., and the fact that one can melt steel scrap for the same or slightly less electricity has been distinctly puzzling, and leads one to wonder whether there is some latent heat required for the dissolving of the 3½ per cent. of carbon in the iron, or whether the amount of sand on the pig-iron may introduce such high resistance as to cause this high electrical consumption.

The process enabled one to add steel scrap, and so to bring down the total carbon to under 3 per cent., and in this way there was made a remarkable series of tough iron castings, quite equal to quality of cold-blast iron, which was the object sought.

A calculation, however, reveals that 850 units per ton at 1.1d. per unit equals £3 17s. 11d. for melting, in addition to the pig-iron and expensive furnace repairs, and again the process was turned down as not being of commercial value.

The quality and toughness were shown in a deflection of 0.54 to 0.56 in. on the 2 × 1 transverse test bar, with a load of 45 cwts., and is a matter of regret to the author that he did not invite others to experiment with the plant for making other commercial castings calling for this low-carbon pig-iron, in order to ascertain how far it answered their purpose.

The high temperature at which the iron was tapped from the furnace must have been very helpful in obtaining sound castings and test bars, but it will be realised that the cost was so high that it was not justified for the particular type of work called for unless it could give a test at least equal to malleable cast iron.

In conclusion, it has been shown in practice (1) that regular cupola practice, good coke, and careful mixing have an improving and regularising effect on commercial cast iron; (2) high casting temperature is always advisable for ensuring the best results on the testing machine; and (3) that the lowering of the total carbon in the iron by means of special melting and steel charges, or, better still, liquid steel additions, has a distinctly improving effect on commercial cast iron.

Cold-blast iron will often give equal tests to steel mixtures as far as the testing machine is concerned, but when applied for practical purposes the steel mixtures may be found superior, which superiority is generally explained by a finer division of the graphitic grains.

DISCUSSION.

The Branch President, LIEUT.-COMMANDER L. JACKSON, R.N., who was in the chair, stated at the opening of the proceedings that an invitation had come from the American Foundrymen's Association to visit the International Convention, and he hoped as many members of the Sheffield Branch would go as possible, as he was sure they would be well entertained. The Americans were pleased with their reception when in England, and he was sure they would return the compliment.

MR. F. A. MELMOTH thought the most interesting part of the paper was the reference to the electric furnace. For a good many years he (the speaker) had been interested in electric furnaces and the production of malleable iron and steel from them. He had never realised the possibility of using 900 units for cast-iron making. Mr. Hyde's explanation was both original and ingenious. He did not quite agree with the reasons put forward that electric furnaces gave superior results to the average cupola product. He was satisfied that the electric furnace product had properties of its own. Irons were produced in electric furnaces under atmospheric conditions which were entirely different from those in the cupola. It was possible for certain tendencies to arise in the cast-iron which were directly due to the atmosphere in which it was melted. He would like Mr. Hyde to tell him the actual analysis of the bars given. He thought the analysis would have shown some useful points in connection with the table. Liquid steel added to liquid cast-iron produced better results, due to the actual fact of lowering the total carbon.

Electric Steel and Cold Blast Compared.

MR. HYDE, in reply, said he agreed that the electric furnace possessed properties of its own; it was the peculiar condition under which the iron was produced with cold blast-furnace. They had iron produced under different conditions from hot blast, and a different quality of pig-iron resulted.

Influence of Low Phosphorus Content.

MR. J. E. HURST said he would have liked to have made some remarks on the question of the phosphorus contents of iron. It was a remarkable thing in connection with cast-iron that low phosphorus contents often gave low tensile tests, yet it was very difficult to break. The transverse strength was not everything in measuring resistance of the breaking of iron. The work done in breaking hematite pig-iron was more than that in breaking cold blast pig-iron. If the transverse test was to be carried out properly it should be carried out in such a manner that the rate of deflection was plotted with increased load. He agreed with Mr. Hyde that future improvement in cast-iron lies along the lines of low carbon content coupled with scientific melting conditions and correct casting temperature.

Tensile Testing Machines for Cast-Iron.

MR. J. SHAW, after congratulating the author on a sound, practical paper, stated that he had only two points to raise. He did not think it wise to expect regular test results from simply charging, say, a No. 3 iron without any knowledge of its composition. It was well known that the same number iron often varied as much as one per cent. in silicon content, not to mention other elements. Where there was no chemical control it was far simpler to make a chill test from a 6-in. by 4½-in. by 1¼-in. test. If the iron showed ⅛ to ¼ depth of chill there was little doubt the 2-in. by 1-in. by 36-in. would give at least 28 cwts., even with large variation in the analysis. When it came to special tests, control of all the elements was vital. Total carbon, as had been mentioned, must be low. Phosphorus up to 0.8 per cent. did not affect the tensile much. Up to 0.3 per cent. P., with other elements suitable, it even increased the transverse, but on increasing up to 1 per cent. there was a fall of about 33 per cent. The deflection showed a fall with every 0.1 per cent. addition, while the impact value dropped roughly 40 per cent. With an increase from 0.2 per cent. to 0.8 per cent. Manganese, on the other hand, showed an increase in the transverse and deflection. Mr. Hyde mentioned that he (Mr. Shaw) thought some of the testing machines did not give true results. While no doubt the improvements he mentioned would improve the tranverse, it was the lack of alignment in the tensile machine that was unsatisfactory. A friend in Scotland some time ago sent some interesting figures. He had a standard tensile bar cast, but with two flanges about 3 in. diameter cast at the root of the fillet of the tested portion. The screwed ends projected beyond these flanges. The bar was turned up to B.E.S.A. specification and the flanges faced parallel. Before putting into the testing machine these flanges were marked A, B and C on the periphery in their places at 120 deg. A gauge was made a good fit between the flanges. When the bar was put into the testing machine and a slight load put on, the gauge would just go in at B. A 1/1,000th feeler would go in between the gauge and the flanges at A and C. When the load of 4.5 tons had been applied, the gauge would not go in at B. A 2/1,000th feeler would go in between the gauge and flanges at A, while it took a 12/1,000th feeler to fill the gap at C. This proved at once that this machine was out of line.

MR. HYDE, replying, said the irons of which he had spoken were cast to one size, *i.e.*, the definite test-bar, 40 in. by 2 in. by 1 in., for uniform comparisons. There was much interesting work for someone to do in the impact testing of cast-iron. In 1918 they had a reversible hammer

test on semi-steel, which showed that material to be superior.

Semi-Steel Rolls.

MR. BARKER asked if Mr. Hyde recommended casting a chilled roll with 20 per cent. steel mix? Was there likely to be a different mixture at the top of the roll to that at the bottom?

MR. HYDE said he did not advise so much steel, but would rely on a pig-iron mixture.

MR. ALLISON said Mr. Hyde had not given them analyses, but the speaker thought that sulphur did not matter at all provided there was sufficient manganese to neutralise it. The total carbon was the one important factor, and the other was silicon. A separate converter from the cupola would have been easier than the combined arrangement described.

MR. HYDE said what he had been endeavouring to place before them was practical routine, which would have the effect of improving the average quality of their castings. When they invariably had a regular product they had reached a condition the outlining of which was the main object of his paper.

A vote of thanks to the author concluded the business.

An American View on Staffing Foundries.

Mr. C. Earnill, who was a delegate to the International Conference of Foundrymen held in Paris in 1923, in a contribution to the "Iron Age," states that he had the opportunity of visiting many of the largest machine plants in England and France. The leading men in industry there have for many years realised the value of having technically trained men in their foundries. To keep this supply sufficient they encourage the young men to enter foundry work.

He noted with interest the manner in which such a well-known man as Sir Robert Hadfield conducted the party through the foundries of the Hadfield Works, Sheffield, England, and explained the entire operation in detail. How many of the executives of the great American organisations could do the same thing?

It is surprising to see how little attention the majority of American universities and colleges give to the foundry instruction of engineering students. There were on June 30, 1925, a total of 366 institutions listed by the various recognised accrediting agencies throughout the United States, and out of which, to personal knowledge, only 39 gave instruction in foundry and pattern work. Many engineering students graduate from these institutions with only a general knowledge of foundry science, due to the short period the student is required to spend in a shop course.

It is essential not to lose sight of the value of a practical shop training for an engineering student. What would science mean to him if he did not know how to apply it? Is it not true that a great many American college graduates expect a white collar job after they have spent four or five years in college?

The University of Illinois conducts its shop laboratories, which includes in its instruction heat treatment, machine, pattern and foundry work, on a strictly manufacturing basis. A two-cylinder, marine type, gas engine is the standard product. The students conduct the work throughout the departments. They deal with practical problems which occur in a manufacturing plant. Each mechanical engineering student spends eight hours a week in the foundry laboratory during the academic year, and performs manual as well as executive work.

Some of the leading electrical firms are co-operating with the technical institutions and are conducting conferences for engineering teachers during the summer months. These firms appreciate the advantage of being in close contact with the schools and realise the importance of co-operation between schools and industry. Many firms are employing engineering students during vacations, and the schools are trying to secure summer employment for their engineering students so that the students may gain some practical experience. Few foundries are co-operating with the schools to this extent.

One cannot expect to get expert foundrymen from any college or university, but one can get technically trained men into the foundry and make foundrymen of them. The problem of scientific and modern control of the foundry is an important problem with present conditions. However, if the technical institutions and foundrymen realised the importance of having a sufficient supply of technically trained foundrymen on hand in the future, this problem should become a minor one.

The American Foundrymen's Association has accomplished a great and important work by standardisation in various branches within its field.

The first attempt of having a conference of instructors of foundry work was made last year at the Rochester convention of foundrymen. The writer is looking forward to a closer co-operation among foundry instructors through this yearly opportunity of meeting and discussing duties toward students and the foundry industry.

Would it not be possible for a committee of foundrymen and foundry instructors to co-operate with the institutions teaching foundry work and formulate a standard instruction in this work?

The instruction should be of such a nature that the students would be trained in the more important features and absorb a sound fundamental knowledge of foundry work. Such a committee could undoubtedly have a great influence concerning the instruction given in high schools where foundry work is given as a manual course. The instruction in the high schools could be so arranged that it would be a preliminary training to that given in the engineering schools. The majority of students taking foundry work in high schools have not to follow this work through life. However, if this work is a part of their training, the writer sees no reason why a standardised instruction should not be given.

In making out a schedule of standard instruction for schools it may be well to start in the high schools. In preparing the form of standardisation the writer does not believe that too much stress should be put upon actual skilled labour such as teaching the students to produce perfect moulds. The schools cannot attempt to compete with the skilled mechanic.

The technical and administrative phases of the foundry should be taught, such as foundry chemistry, metallurgy, metallography, sand testing, scientific management, control of production, time study and dispatching. The actual skill cannot be obtained from any college or university course, but a student who graduates from a course in foundry work should have a fundamental knowledge sufficient to enable him, in a few years of practical work, to do the more important work in the foundry.

A variation in the kind of instruction given in different parts of the country would be necessary. Instruction in an automobile centre should be slightly different from that given in a pipe manufacturing centre. Standardised instruction cannot harm students, and even if the majority of students do not receive any direct benefit, the students who intend to follow the foundry business should benefit, and likewise the foundry business must benefit.

It is surprising to see that a number of foundry courses are given under the supervision of departments such as chemistry or electrical engineering. It would indeed seem far more satisfactory if these courses were given in connection with the mechanical engineering department where other shop courses generally are given.

The importance of teaching a course that is up to date and true to modern manufacturing conditions should be the aim of our schools. That, of course, would mean that obsolete equipment which is now most extensively used should be condemned, and modern machinery installed in its place. How can one expect to instruct engineering students in up-to-date methods from old and obsolete equipment.

The "VULCANIA" PATENT WHEEL MOULDING MACHINE.

Patent No. 5049.

THE "VULCANIA" PATENT WHEEL MOULDING MACHINE is for moulding spur wheels with straight, sloping or Vee-shaped teeth, also bevel wheels, skew gear wheels, worm wheels and internal wheels. The machine head is carried on a pillar which is held in a base-plate bedded in the floor sand, and is made to slide on the pillar by means of a lever and link carried on a joint bearing, or by rack and pinion, or screw if thought advisable for the particular work it is being used for.

An adjustable stop collar is provided for accurately deciding the depth of mould. On the removable head a slide is carried for supporting the patterns of the teeth to be moulded. This slide is made adjustable by screw or pinion gearing to the diameter required. The number of teeth to be moulded is decided by a special dividing plate into which a steel wedge or finger engages. The special dividing plate has milled vees, at the angle of 60° inclusive, around its circumference, to receive the steel wedge, which is adjusted by a screw having an internal spring to keep it in tension and to lock the head when ramming operations are being carried out.

JAMES EVANS & CO., BRITANNIA WORKS,
(MANCHESTER), LIMITED,
BLACKFRIARS, MANCHESTER.

The Selling of Castings.—XXVIII.

BY VOYAGEUR.

Overseas Selling.

The various factors in selling castings have been dealt with fairly comprehensively in this series, and if the founder has carried out all or most of the suggestions given, he will have set up a pretty effective organisation for the marketing of his castings. It still remains, nevertheless, to make sure that this organisation shall be as efficient in foreign and colonial countries as it is in the British Isles.

Some attention must, therefore, be paid to the means by which castings are sold in foreign lands. Adaptation and modification of the different schemes described in earlier articles will be essential, and it will therefore be advantageous to pass these in review briefly before going on to discuss marketing agencies, branches, and so forth.

Overseas advertising is divisable into two parts, colonial and foreign. In the former instance, English being generally the standard language, it is unnecessary to alter radically the form and style of the text employed. In foreign countries, however, where English is not the staple tongue, advertising to be effective must be in the native language. This at once introduces the subject of efficient translation. Competent translators of foundry technicalities are not easily found, and in this country their discovery is almost an impossibility. As an instance of the sort of error all too frequently made, one may mention "fonte" (which means cast iron, or iron casting) as the translation of "steel casting" (for which the expression "moulage en acier" should be used). One translator even wrote a circular letter beginning "Dear Horses," having used the Spanish word "caballos" instead of "caballeros" (which means "gentlemen").

To be sure of getting good translations, one should send the text in English to the agent or branch office in the respective country, and get him or them to procure a competent translator, and to supervise the translation, whether done in his or their own office, or by an outside person. This makes the agent or branch office manager responsible, and he will take the proper care to ensure the provision of an adequate translation because a poor, stupid, or ridiculous one, will react unfavourably upon his own sales.

The founder must also bear in mind that just as idiomatic English is not quite the same as idiomatic American, so there are differences between the languages of other countries, even when these are the same in root or construction. For example, Brazilian Portuguese is not the same as European Portuguese, and Argentinian Spanish is not the same as European or Mexican Spanish. To publish for the benefit of a Brazilian Portuguese an advertisement couched in European Portuguese is pretty much like addressing an Englishman in idiomatic and full-flavoured American. The result is the same in both instances, it isn't liked.

Apart altogether from the matter of translation, there are other points to bear in mind in foreign advertising. Illustrations should be designed to suit the country for which they are intended. If human beings appear in the advertisement, they should be dressed not as English people dress (unless they are supposed to be English people), but as the people of the country itself dress. To advertise a casting in the United States of America, one should not show a "satisfied user" in English overalls and cap, but in the American peaked cap and dungarees.

Overseas purchasers pay special attention to certain selling-arguments that are not so important from the home purchaser's point of view, and are therefore easily overlooked by the founder. These points should be dealt with in advertisements for abroad more often than they would be in advertisements in home journals. In order of importance, these points are:—(a) the price of the castings; (b) facilities for their purchase; (c) the way in which they are packed and protected for long-distance shipment; (d) method of payment; (e) extent of credit allowed; (f) time of delivery.

If the founder has a trade-mark for his castings, he should feature this in all his advertisements, because it is of great value in overseas marketing. In China, for example, commerce with Europe is largely carried on by importing merchant houses. The native Chinese know little or no English, but they speedily recognise and remember a simple trade-mark, and if they have learned to trust goods branded with a particular mark, they are extremely conservative in their adherence to them. They will indicate to the compradors by signs imitative of the mark that they want goods bearing a particular mark. Advertisements for the Chinese market should, therefore, bear this fact in mind. They should carry the trade-mark prominently, and the castings themselves should have it also cast or stamped upon them prominently. To familiarize the merchant with the possessor of a particular trade-mark is to ensure that orders are passed on when received from the native.

The printing presses of many overseas lands are not as good as those to be found in this country, and if the founder lets his advertisements be set up by them, he will find them often enough rendered almost unrecognisable. The way to get over this difficulty is to have the advertisement set up in type by a printer in England, exactly as it should be. Then a matrix and stereos should be made from the complete advertisement. The matrix should be kept, since any number of stereos can be made from it, but the stereos should be sent out (they are inexpensive and light) to the offices of the various journals overseas that carry the founder's advertisements, with instructions that these alone are to be used. They cost less than blocks to post, and the founder will then be certain that his announcements will appear as he wished in the journals themselves.

In the next article of this series, the writer will deal with overseas catalogues and circularising, and the modifications of domestic plans necessary for success to be achieved overseas by the use of these two powerful factors.

Darwins, Limited.

Amalgamation of Sheffield Firms.

A company known as Darwins, Limited, has been formed, with a nominal capital of £500,000, in order to amalgamate and take over the following allied businesses:—

Darwin and Milner, Limited, Sheffield: Sybry, Searls & Company, Limited, Sheffield; Spartan Steel Company, Limited, Sheffield; Nelson Tool Company, Limited, Sheffield; Cobalt Magnet Steel Company, Limited, Sheffield; Akrat Steel and Wire Mills Company, Limited, Sheffield; Beeley Wood Steel Company, Limited, Sheffield; Sheffield Annealing Works, Limited, Sheffield; Hos-Syb Works, Limited, Sheffield; Birks, Stevens & Son, Limited, Sheffield; Darwin and Milner Inc., Cleveland, Ohio, U.S.A.; Darwin and Milner, Limited, Brussels; Neuenteichwerk, Lennep, Rhld; the administration of which is centred in the recently-acquired Fitzwilliam Works, Templeborough, Sheffield.

The various sections of the business are continuing under the same management and trade-marks, and manufacturing will also still be carried on at the Cannon Steel Works, Carlisle Street, Sheffield; Beeley Wood Forge, Sheffield, and Akrat Steel and Wire Mills, Sheffield.

MR. JOHN HINCHLIFFE, who has died at Bournemouth, was for many years a prominent official of Sir W. G. Armstrong, Whitworth & Company, Limited, at Elswick shipyard. Born in 1846, near Huddersfield, Mr. Hinchliffe was apprenticed to James Trowsdale & Son, railway contractors. On the suspension of that firm he joined the shipbuilding firm of S. P. Austin & Son, at Sunderland. In 1874 he became assistant accountant at the Walker shipyard of Charles Mitchell & Company, and on the opening of the Elswick shipyard in 1884—following the amalgamation of Charles Mitchell & Company—he was appointed to the position of commercial manager at that establishment, which position he held until his retirement in 1913.

BLACKING,
PLUMBAGO,
CORE GUM,
WHITE DUST,
COAL DUST.

ESTABLISHED 1863

JAS. DURRANS & SONS, LTD.
PHOENIX WORKS, PENISTONE, near SHEFFIELD.

Telephone:
21 PENISTONE.

Telegrams:
"DURRANS, PENISTONE."

Manufacturers of
FOUNDRY EQUIPMENTS

LADLES,
FIRE BRICKS,
STONE FLUX,
CASTING CLEANERS,
PIPE NAILS,
SPRIGS,
WIRE BRUSHES,
BELLOWS,
CUPOLAS,
GANISTER,
LOAM AND SAND MILLS,
STUDS,
CHAPLETS,
BRUSHES,
CORE ROPES.
BUCKETS,
SPADES, Etc.

Write for Illustrated Catalogue on Blacking and Foundry Requisites, also for our latest Price List.

SIEMENS' STEEL PROCESS

BOILER, SHIP and BRIDGE PLATES, etc. ANGLES and all forms of Sectional Bars. TYRES and AXLES to all requirements. CASTINGS of all kinds and of Largest Sizes. FORGINGS of every description. BILLETS, BLOOMS, RAILS.

SPECIAL STEEL FOR CONSTRUCTIVE PURPOSES.

The STEEL COMPANY OF SCOTLAND, Ltd.

Head Office: 23, ROYAL EXCHANGE SQUARE, GLASGOW.
Works: HALLSIDE, NEWTON and BLOCHAIRN, GLASGOW.

CONTRACTORS TO HOME, COLONIAL AND FOREIGN GOVERNMENTS.

Established 1872. *Telegraphic Address: "Steel, Glasgow."*

GANISTER, CUPOLA BLOCKS, FIRE BRICKS,
FIRE CLAY.

Silica Bricks, Tuyeres, Stoppers, Nozzles, &c.

STEEL MOULDERS' COMPOSITION, SILICA CEMENT.

J. GRAYSON LOWOOD & Co., Ltd.
DEEPCAR, nr. SHEFFIELD.

Telegrams: "LOWOOD, DEEPCAR."

Trade Talk.

W. C. BRANDES & COMPANY, 38, Leadenhall Street, London, E.C.3, have been appointed London agents for the Ferrostaal g.m.b.h.

CRAVENS, LIMITED, of Darnall, Sheffield, have booked an order from the London & North-Eastern Railway Company for about fifty main line coaches, representing about £140,250.

THE WORKS of the Whitford Steel Sheet and Galvanising Company, Limited, Briton Ferry, Glamorgan, were restarted last week with imported coal, giving work to more than 500 men.

W. H. ARNOTT, YOUNG & COMPANY, iron and steel merchants, have removed their Glasgow offices from 55, West Regent Street, Glasgow, C.2, to new premises at the Fullarton Iron Yard, Tollcross, Glasgow.

THE appointment of a receivership for the Dominion Iron and Steel Company follows upon a period of severe depression. The National Trust Company has been authorised to continue the business as a going concern.

RANSOMES & RAPIER, LIMITED, are supplying equipment, including electric traversers, electric cranes, electric locomotive hoists, locomotive and wagon turntables, etc., to Indian, Dutch East Indies, Sudan, African, South American, and New South Wales Railways.

THE EDINBURGH TOWN COUNCIL has accepted the tender of the British Brown Boveri Company to supply two 250,000 k.w. turbo-alternators, at a cost of £138,000, for the electricity station. There was a difference of £52,000 between the nearest British offer.

FRIED. KRUPP GRUSONWERK, Aktiengesellschaft, Magdeburg-B., announce that their representative, Mr. W. Stamm, of 63, Queen Victoria Street, London, E.C., has expressed the wish to be relieved of the increasing work attached to the agency, and the company have accordingly concluded arrangements with J. Rolland & Company, Abbey House, 2, Victoria Street, London, S.W.1, to take over their representation as from July 1. Mr. Stamm will collaborate with J. Rolland & Company in the agency.

THE POWER PLANT COMPANY, LIMITED, of West Drayton, Middlesex, have acquired an exclusive licence for the manufacture and sale of the Richards thread milling machine, and intend to introduce new and improved models in addition to those now on the market. The latest models have been specially designed to meet the requirements of the tube trade, and in addition to threading, will complete at one setting all the machining required on tube ends or sockets as used on the oilfields, and permit the production of a thread which will give a metal to metal joint to withstand high pressures.

ONE OF THE largest orders ever placed in Great Britain for pipe-line and casing has lately been given out by the Anglo-Persian Oil Company. It is of the value of about £265,000. The contract covers thirty-four miles of 12-in. pipe-line, fifty-six miles of 10-in., and fifty-eight miles of casing, making in all 148 miles of piping. The combined weight is over 14,000 tons, of which 9,630 tons represents line-pipe. The order for the pipe-line has been placed with Stewarts & Lloyds, Limited, and that for the casing jointly with Stewarts & Lloyds, Limited, and the British Mannesmann Tube Company, Limited.

PARTICULARS are now available regarding the proposed new works at Stoke-on-Trent for the Michelin Tyre Company, to be erected by Peter Lind & Company, 2, Central Buildings, Westminster, in collaboration with Saxild & Partners, of the same address. The contract value will be over £300,000. It comprises several single-storied buildings covering a ground area of 400,000 square feet; a multistoried reinforced concrete building with 45,000 square feet floor area; a boiler and power house with overhead coal bunkers, in reinforced concrete, accommodating four "Stirling" boilers; a building containing nine underground petrol storage tanks; a reinforced concrete enclosure wall 10 feet high by 3,000 yards long; 20,000 square yards of macadam roads; all necessary rainwater and soil drains as well as all sanitary arrangements. All the single-storied buildings consist of steel framework (which is outside the contract) with outside walls of hollow concrete blocks or brickwork, partitions of brick or breeze concrete blocks. The roofs are, generally speaking, North-light shaped, covered with tiles and about 150,000 square feet of glazing. The contract also includes for painting about 3,000 tons of structural steelwork as well as providing all necessary down-pipes, windows and doors; in fact, it includes everything required for the buildings with the exception of the structural steelwork which has been ordered partly from Edward Wood & Company, Limited, Ocean Works, Manchester, and partly from a French firm. As the ground on which the buildings have to be erected is not very good, all the buildings will probably be carried on foundations of reinforced concrete piles and beams.

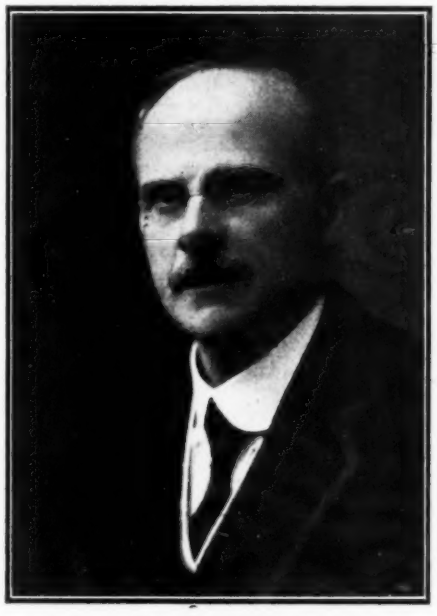
Personal.

MR. LEWIS JONES, secretary of the South Wales Siemens Steel Association, is now on his way to America.

MR. C. F. SUTRO has been admitted into partnership with Runge & Company, 120, Fenchurch Street, London, E.C.3.

MR. H. JOHNSON, of Howick, Bolton, has been appointed foreman over the repair shop of the Sudan Government's steamers, Atbara, Sudan.

MR. H. B. WEEKS, who has been chief chemist and metallurgist to Vickers, Limited, for many years, has retired from full-time employment with that firm. His services are, however, being retained in a consultative capacity for the whole of the members of the Vickers group. The arrangement, we understand, leaves Mr. Weeks free to take up consultation work for other people whose businesses do not conflict with the Vickers interests. He was a director of James Booth & Company (1915), Limited, is chairman of the council of the British Cast Iron Research Association, a member of the council of the Institute of Metals, a member of the Iron and Steel Institute, a Fellow of the Institute of Chemistry, and of the Chemical



MR. H. B. WEEKS.

Society, a member of the Society of Chemical Industry and of the Engineering Group thereof. Mr. Weeks was formerly engaged in Government service at Woolwich Arsenal and Waltham Abbey, and was for five years chief chemist and metallurgist in the Ordnance Department of India before joining Vickers, Limited, and was responsible for the latter acquiring the rights for the manufacture of "Duralumin."

Obituary.

HERR O. WIEDFELDT, managing director of Krupps, died as Essen last week after a long illness.

THE DEATH has occurred suddenly, at the age of 47, of Mr. A. Chatwin, a director of Thomas Chatwin & Company, Limited, of Great Tindal Street, Birmingham.

MR. R. H. KRAUSE, who has died at the age of 69 years, was for a long period prior to the war connected with Stewarts & Lloyds at Coombs Wood Tube Works, Halesowen, where he held the position of director. Soon after the outbreak of war Mr. Krause took control of the firm's works at Glasgow, and rendered great service in increasing the production of shells.

MR. P. WALLACE, who was well known in West of Scotland shipping circles, died on June 30 at his residence in Bearsden, Glasgow. Mr. Wallace was born at Gateshead in 1851, and at the age of twelve years went to Glasgow to join the firm of A. and J. Inglis, Pointhouse, and rose to be chief draughtsman, and afterwards works manager. In 1886 he founded the Ailsa Shipbuilding Company at Troon in association with the late Mr. G. L. Watson. Mr. Wallace was a member of council of the Institution of Engineers and Shipbuilders in Scotland, and a member of the Institution of Naval Architects.

Sterling

ARE YOU MAKING CASTINGS?

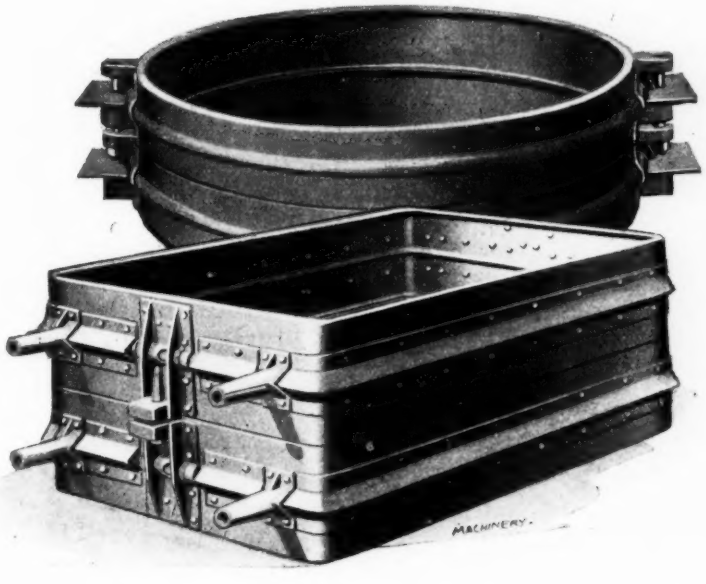
that is, good, accurate castings, all true to pattern and requiring only a modicum of fettling.

OR WASTERS?

cross-jointed abortions, all fins and flashings, fifty per cent. rejects, the best only doubtful.

FOR THE PRODUCTION OF GOOD CASTINGS AN ACCURATE, WELL-FITTED MOULDING BOX IS HALF THE BATTLE.

If permanent accuracy and correct design were the only features of STERLING BOXES, their claim for your adoption would be more than justified. There are, however, many other advantages, notably their lightness in weight, freedom from breakage, and rigid rolled steel construction.



STERLING FOUNDRY SPECIALTIES LTD.
BEDFORD

London Office: 13, VICTORIA STREET, S.W.1.

IRON AND STEEL MARKETS.

Pig-Iron.

MIDDLESBROUGH.—For the time being, business in the Cleveland iron trade remains in *statu quo*, the few transactions reported being almost entirely confined to small deliveries on contract account, with but faint prospects of an early renewal of normal activity. With regard to export trade, the Tees-side shipments of pig-iron during June amounted to 23,640 tons—5,290 tons coastwise and 18,350 tons abroad—as against only 4,923 tons in May. The big difference between May and June is due to the fact that during practically the whole of the former month shipments were held up by the dockers' strike in the Tees. Quotations continue steadily on the up-grade, now ruling as follow: No. 1, 90s.; No. 3 G.M.B., 87s. 6d.; No. 4 foundry, 86s. 6d.; and No. 4 forge, 86s. per ton. The North-East Coast hematite position is practically unchanged. The volume of the stocks in hand precludes any run-away in prices, and a few moderate lots of mixed numbers are being disposed of at figures varying from 79s. 6d. to 80s. 6d. per ton, 80s. per ton being an average figure. On the North-West Coast, prices have been advanced by 1s. 6d. per ton, Bessemer mixed numbers now being quoted at £4 4s. per ton c.i.f. Welsh ports, £4 6s. 6d. to £4 8s. per ton delivered at Glasgow, £4 9s. 6d. to £4 11s. 6d. per ton delivered at Sheffield, and £4 15s. to £4 16s. 6d. per ton delivered at Birmingham.

LANCASHIRE.—Only limited stocks of foundry pig are now available for local consumers, chiefly Scottish No. 3 and hematite qualities, the first-named quality having advanced from 97s. to 97s. 6d. per ton for forward delivery, but for prompt business, whenever this is possible to effect, up to 102s. 6d. per ton being asked at one time, although about 100s. is perhaps nearer the present figure.

THE MIDLANDS.—In this area, as elsewhere, supplies of iron from the Midland furnaces are now almost unobtainable, but until quite recently it was possible to get No. 3 Middlesbrough at about £5 per ton, with No. 1 at £5 2s. 6d. per ton; but it is understood that there is very little more of the No. 3 available, although a fair tonnage of No. 1 iron is coming through. Apart from this, there is only Scotch iron, and this is in limited quantities at a figure round about £5 5s. per ton, delivered.

SCOTLAND.—Demand for pig-iron on Clydeside is at present confined almost solely to the foundries, which, fortunately, are still doing fairly well, and taking supplies regularly. Some makers have again advanced their prices, and as high as 85s. is being asked in some cases for No. 3 foundry Scotch iron.

Metals.

Copper.—Movements in standard copper over the past week disclosed about an average season demand, with values, on the whole, a shade firmer in tendency. A recent report states that the newly-created combination of American producers is not to come into action for some time, and it is rumoured that a period of about a month may elapse before this trading concern commences to function; in fact, one report states that this event may be put off until early autumn.

Official closing prices of standard copper have been as under:—

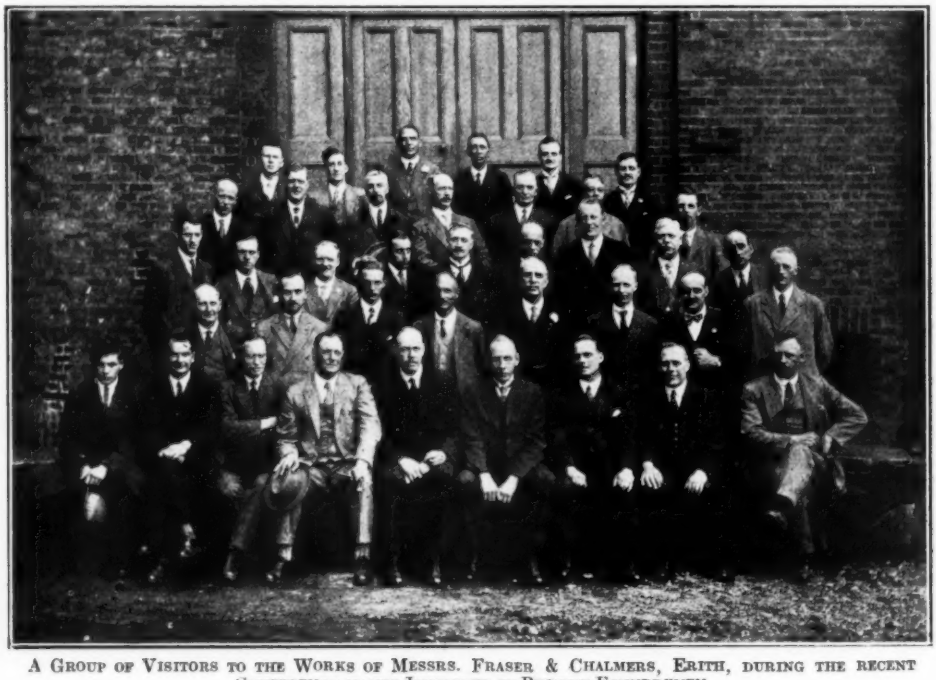
Cash: Thursday, £57 5s.; Friday, £57 7s. 6d.; Monday, £57 17s. 6d.; Tuesday, £57 17s. 6d.; Wednesday, £58 5s.

Three Months: Thursday, £58; Friday, £58 5s.; Monday, £58 12s. 6d.; Tuesday, £58 12s. 6d.; Wednesday, £59.

Tin.—During the past week a steady appreciation of tin values was apparent, and at the close quotations marked an advance of about £4 on those of the previous week. The New York market is also reported as being stronger, but this does not seem to be on account of an increased demand, or because of the famine in tin, which is constantly spoken of as coming in a few years' time, but rather is it believed to be a reflection of the higher prices quoted on the London Exchange earlier in the week.

Official closing prices of standard tin have been as follow:—

Cash: Thursday, £277 10s.; Friday, £277 10s.; Monday, £277 5s.; Tuesday, £278 5s.; Wednesday, £280 10s.



A GROUP OF VISITORS TO THE WORKS OF MESSRS. FRASER & CHALMERS, ERITH, DURING THE RECENT CONFERENCE OF THE INSTITUTE OF BRITISH FOUNDRYMEN.

Three Months: Thursday, £277 10s.; Friday, £277 2s. 6d.; Monday, £277; Tuesday, £277 17s. 6d.; Wednesday, £280.

Spelter.—The position in this section, though still affected by current industrial difficulties, is not altogether lacking in promise of improvement, which is confirmed by a further advance in the week's quotations, and an undercurrent of firmness in the market. It is reported that the Continent is engaged on a German order, and that delivery of any new orders cannot be executed under about two months, on account of the great activity there.

The following are the week's prices:—

Ordinary: Thursday, £33 18s. 9d.; Friday, £34 1s. 3d.; Monday, £34 6s. 3d.; Tuesday, £34 7s. 6d.; Wednesday, £34 7s. 6d.

Lead.—In the market for soft foreign pig, values again indicate a steady, consistent tendency in spite of the difficulties in obtaining fuel supplies for industrial concerns. The reason for the higher prices now ruling on the London market may be due partly on account of the low stocks held by American consumers, or possibly as a result of the optimism of British manufacturers, who are fortunate enough to be able to obtain supplies of Continental coal for their works.

The week's prices are appended:—

Soft foreign (prompt): Thursday, £30 17s. 6d.; Friday, £30 17s. 6d.; Monday, £31 3s. 9d.; Tuesday, £31 8s. 9d.; Wednesday, £31 16s. 3d.

"SERVICE GRC FIRST"

WE ARE STILL CARRYING ON

in all departments, and can execute orders for any class or kind of refractory material.

We are independent of outside coal supply, and will welcome enquiries of all kinds.

GENERAL REFRACTORIES Co., Ltd., SHEFFIELD.

BCM/OK9
LONDON.

No need to try and remember our name in case it is unfamiliar to you. This is our British Monomark. Envelopes addressed simply thus will be delivered to us by arrangement with the G.P.O.

THE FOUNDRY TRADES EQUIPMENT & SUPPLIES ASSOCIATION LTD.

WEEKLY PRICE CURRENT.

COPPER.

	£	s.	d.
Standard cash ..	58	5	0
Three months ..	59	0	0
Electrolytic	66	0	0
Tough	62	15	0
Best selected ..	63	5	0
Sheets	90	0	0
India	74	0	0
Wire bars	66	0	0
Do. July–August	65	15	0
Do. Aug.-Sept...	65	17	6
Ingot bars	65	12	6
H.C. wire rods ..	70	0	0
Off. av. cash, June	56	16	9 9/11
Do., 3 mths. June	57	14	1 1/11
Do.,Sttlmnt, June	56	17	1 10/11
Do., Electro, June	64	16	7 1/11
Do., B.S., June ..	62	4	2
Aver. spot price copper, June ..	56	17	2
Do.,wire bars, June	65	11	4½
Solid drawn tubes			12½d.
Brazed tubes ..			12½d.
Wire			9½d.

BRASS.

Solid drawn tubes ..	11¾d.
Brazed tubes	13½d.
Rods, drawn	10½d.
Rods, extd. or rlld. ..	7½d.
Sheets to 10 w.g ..	10½d.
Wire	9½d.
Rolled metal	9½d.
Yellow metal rods ..	7½d.
Do. 4 × 4 Squares	8d.
Do. 4 × 3 Sheets ..	8½d.

TIN.

	£	s.	d.
Standard cash ..	280	10	0
Three months ..	280	0	0
English	278	10	0
Bars	279	10	0
Straits	287	5	0
Australian	278	0	0
Eastern	285	15	0
Banca	287	5	0
Off.avr. cash,June	268	9	5 19/22
Do.,3 mths.,June	267	13	0 3/22
Do.,Sttlmt. June	268	8	7 7/11
Aver. spot., June	268	9	6

SPELTER.

	£	s.	d.
Ordinary	34	7	6
Remelted	33	10	0
Hard	29	5	0
Electro 99.9 ..	37	5	0
English	35	0	0
India	31	10	0
Zinc dust	42	0	0
Zinc ashes	15	0	0
Off. aver., June	33	6	5 1/22
Aver., spot, June	33	4	10 3/4

LEAD.

	£	s.	d.
Soft foreign ppt.	31	16	3
English	33	0	0
Off. average, June	30	1	3 15/22
Average spot, June	29	19	8½

ZINC SHEETS, &c.

Zinc sheets, English	42	0	0
Do. V.M. ex whf.	38	10	0
Rods	44	0	0
Boiler plates ..	38	10	0
Battery plates ..	38	0	0

ANTIMONY.

Special brands, Eng.	74	10	0
Chinese	61	0	0
Crude	33	0	0

QUICKSILVER.

Quicksilver ..	15	5	0

FERRO-ALLOYS AND STEEL-MAKING METALS.

Ferro-silicon	
25%	9 0 0
45/50%	11 5 0
75%..	19 10 0
Ferro-vanadium—	
35/40% ..	15/- lb. va.
Ferro-molybdenum—	
70/75% c. free ..	5/9 lb.
Ferro-titanium—	
23/25 carbonless	11½d. lb
Ferro-phosphorus, 20/25%,	£17 0 0
Ferro-tungsten—	
80/85%,c.fr. ..	1/4½ lb.
Tungsten metal powder—	
98/99% ..	1/10½ lb.
Ferro-chrome—	
2/4% car. ..	£33 10 0
4/6% car. ..	£22 0 0
6/8% car. ..	£21 10 0
8/10% car. ..	£20 15 0
Ferro-chrome—	
Max. 2% car.	£37 0 0
Max. 1% car.	£43 10 0
Max.0.70%car.	£54 10 0
70%,carbonless	1/5½ lb.
Nickel—99%, cubes or pellets ..	£170
Cobalt metal—98/99%	10/- lb.
Aluminium 98/99%	£118
Metallic Chromium—	
96/98% ..	3/3 lb.
Ferro-manganese (net)—	
76/80%, loose	£15 0 0
76/80%, packed	£16 0 0
76/80%, export	£14 5 0
Metallic manganese—	
94/96%, carbonless	2/- lb.

Per ton unless otherwise stated.

HIGH-SPEED TOOL STEEL.

Finished bars, 14% tungsten ..	s. d. 2 6
Finished bars, 18% tungsten ..	3 0

Per lb. net, d/d buyers' works.

Extras—

Rounds and squares 3 in. and over .. 4d.lb.

Rounds and squares under ½ in. to ¼ in. 3d. lb.

Do. under ¼in. to ⅛ in. .. .. 1/- lb.

Flats, ½in. × ⅛in. to under 1 in. × ⅛ in. 3d. lb.

Do. under ½in. × ⅛in. 1/- lb

Bevels of approved sizes and sections 6d. lb.

Bars cut to length 10% extra

Scrap from high-speed tool steel—

Scrap pieces .. .. 3d.

Turnings and swarf 1d.

Per lb. net, d/d steel makers' works.

SCRAP.

South Wales—	£	s.	d.		£	s.	d.
Hvy. steel	3	5	0				
Bundled steel & shrngs.	3	3	0	to	3	6	0
Mixed iron & steel					3	0	0
Heavy cast iron					3	2	6
Good machinery for foundries ..	3	5	0				
Cleveland—							
Heavy steel ..	3	1	0				
Steel turnings ..	2	6	0				
Cast iron borings	2	5	0				
Heavy forge ..	4	2	6				
Bushelled scrap	3	10	0				
Cast-iron scrap	3	11	0				
Lancashire—							
Cast-iron scrap	3	2	6	to	3	10	0
Hvy. wrought ..	3	2	6				
Steel turnings ..	2	2	0				

London — Merchants' buying prices delivered yard.

Copper (clean)..	48	0	0
Brass (clean) ..	39	0	0
Lead (less usual draft)	27	0	0
Tea lead ..	22	0	0
Zinc	22	0	0
New aluminium cuttings ..	80	0	0
Braziery copper	44	0	0
Gunmetal ..	45	0	0
Hollow pewter	180	0	0
Shaped black ewter ..	132	0	0

PIG-IRON.

(*f.o.t. unless otherwise stated*).

N.E. Coast—	
Foundry No. 1 ..	90/-
Foundry No. 3 ..	87/6
Foundry No. 4 ..	86/6
Forge No. 4	86/-
Hematite No. 1 ..	80/6
Hematite M/Nos. ..	80/-
N.W. Coast—	
Hem. M/Nos. d/d Glas.	87/6
,, d/d Birm.	95/9
Midlands—	
Staffs common* ..	—
,, No. 4 forge ..	—
,, No. 3 foundry	—
Shrops. basic	—
,, Cold blast, ord.*	—
,, ,, roll iron* ..	—
* d/d Birmingham.	
Northants forge	—
,, fdry No. 3 ..	—
Derbyshire forge ..	70/-
,, fdry. No. 3 ..	90/-
,, basic	—
Scotland—	
Foundry No. 1 ..	90/-
,, No. 3 ..	85/-
Hem. M/Nos.	79/-
Sheffield (d/d district)—	
Derby forge	—
,, fdry. No. 3 ..	—
Lincs. forge	—
,, fdry. No. 3 ..	—
E.C. hematite	91/-
W.C. hematite ..	90/6
Lincs. (at furnaces)—	
Forge No. 4	—
Foundry No. 3.. ..	—
Basic	—
Lancashire (d/d eq. Man.)—	
Derby forge	—
,, fdry. No. 3 ..	100/-
Northants foundry No. 3	—
Dalzell, No. 3	—
Summerlee, No. 3 ..	—
Glengarnock, No. 3 ..	—
Gartsherrie, No. 3 ..	—
Monkland No. 3	—
Coltness, No. 3	—
Shotts, No. 3	—

FINISHED IRON & STEEL.

Usual District deliveries for iron; delivered consumers' station for steel.

Iron—	£	s.	d.		£	s.	d.
Bars(cr.)	11	5	0	to	12	0	0
Angles					11	10	0
Tees to 3 united ins.					12	0	0
Nut and bolt	10	5	0	to	10	7	6
Hoops	14	0	0	to	15	0	0
Marked bars (Staffs.) f.o.t. ..					14	0	0
Gas strip					12	10	0
Bolts and nuts ¾ in. × 4 in. ..					15	5	0
Steel—							
Ship plates					8	2	6
Boiler plts. ..					11	5	0
Chequer plts. ..					10	0	0
Angles					7	7	6
Tees					8	7	6
Joists					7	7	6
Rounds and Squares 3 in. to 5½ ins. ..					8	0	0
Rounds under 3 in. to ⅜ in.					7	15	0
Flats, over 5 in. wide and up ..					8	10	0
Flats, 5in. to 1½in.					7	10	0
Rails, heavy ..					8	0	0
Fishplates					12	0	0
Hoops (Staffs.) ..					10	10	0
Black sheets, 24g.					10	17	6
Galv. cor. sheets, 24g.					16	10	0
Galv. fencing wire 8g. plain					13	0	0
Billets, soft ..					6	10	0
Billets, hard ..					8	2	6
Sheet bars					6	5	0
Tin bars d/d ..					6	5	0

PHOSPHOR BRONZE.

	Per lb.	basis.
Strip	1	3
Sheet to w.g.	1	3½
Wire	1	3½
Rods	1	3
Tubes	1	8
Castings	1	2

Delivery 3 cwt. free

10% phos. cop. £40 above B.S.

15% phos. cop. £50 above B.S.

Phosphor tin (5%) £30 above price of English ingots.

C. CLIFFORD & SON, LIMITED.

NICKEL SILVER, &c.

	Per lb.
Ingots for raising	9d. to 1/3
Rolled—	
To 9 in. wide	1/3 to 1/9
To 12 in. wide	1/3½ to 1/9½
To 15 in. wide	1/3½ to 1/9½
To 18 in. wide	1/4 to 1/10
To 21 in. wide	1/4½ to 1/10½
To 25 in. wide	1/5 to 1/11
Ingots for spoons and forks ..	9d. to 1/5½
Ingots rolled to spoon size ..	1/- to 1/8½
Wire round—	
3/0 to 10 G.	1/6½ to 2/1½

with extras according to gauge.

AMERICAN IRON & STEEL.

At Pittsburgh unless otherwise stated.	Dols.
No. 2X foundry, Phila.	21.76
No. 2 foundry, Valley	19.76
No. 2 foundry, Birm.	21.00
Basic	19.76
Bessemer	20.76
Malleable	19.51
Grey forge	19.01
Ferro-mang. 80% d/d	88.00
Bess. rails, h'y, at mill	43.00
O.-h. rails, h'y at mill	43.00
Bess billets	35.00
O.-h. billets	35.00
O.-h. sheet bars ..	36.00
Wire rods	45.00
	Cents.
Iron bars, Phila. ..	2.22
Steel bars	2.00
Tank plates	1.90
Beams, etc.	2.00
Skelp, grooved steel ..	1.90
Skelp, sheared steel ..	1.90
Steel hoops	2.50
Sheets, black, No. 28..	3.10
Sheets, galv., No. 28 ..	4.25
Sheets, blue an'l'd, 9 & 10	2.30
Wire nails	2.65
Plain wire	2.50
Barbed wire, galv. ..	3.35
Tinplate, 100 lb. box	$5.50

COKE (at ovens).

Welsh foundry	—
,, furnace	—
Durham & North.	
,, foundry	—
,, furnace	—
Other Districts, foundry	—
,, ,, furnace (basis)	—

TINPLATES.

f.o.b. Bristol Channel ports.

I.C. Cokes,	20×14, box	25/3
,,	28×20, ,,	50/6
,,	20×10, ,,	—
,,	18¾×14, ,,	—
C.W.	20×14, ,,	23/3
,,	28×20, ,,	—
,,	20×10, ,,	—
,,	18¾×14, ,,	—

Terneplates 28×20, 37/- per box basis f.o.b.

SWEDISH IRON.

Bars,hammered	£18/10 to £19/0
Rolled Ord.	£15/10/0 to £16
Nail rods	£16 5 0 to £16 15 0
Keg. steel nom.	£33 to £35
Faggot steel nom.	£22 to £25
Blooms, according to quality	£9 to £12
Pig-iron	£6 5 0 to £7 0 0

all f.o.b. Gothenburg.

TUBES AND FITTINGS.

Up to and incl. 6 in.

	Tubes	*Fittings*
Gas	60%	50%
Water	55%	45%
Steam	50%	40%

W.I. 10% extra.

DAILY FLUCTUATIONS.

Standard Copper (Cash).

		£	s.	d.	
July	8	57	5	0	inc. 2/6
,,	9	57	7	6	,, 2/6
,,	12	57	17	6	,, 10/-
,,	13	57	17	6	No change
,,	14	58	5	0	inc. 7/6

Electrolytic Copper.

		£	s.	d.	
July	8	65	0	0	inc. 5/-
,,	9	65	0	0	No change
,,	12	65	10	0	inc. 10/-
,,	13	65	10	0	No change
,,	14	66	0	0	inc. 10/-

Standard Tin (Cash).

		£	s.	d.	
July	8	277	10	0	inc. 22/6
,,	9	277	10	0	No change
,,	12	277	5	0	dec. 5/-
,,	13	278	5	0	inc. 25/-
,,	14	280	10	0	,, 45/-

Tin (English ingots).

		£	s.	d.	
July	8	277	0	0	inc 50/-
,,	9	277	0	0	No change
,,	12	276	15	0	dec. 5/-
,,	13	277	10	0	inc. 15/-
,,	14	278	10	0	,, 20/-

Zinc Sheets (English).

		£	s.	d.	
July	8	42	0	0	No change
,,	9	42	0	0	,, ,,
,,	12	42	0	0	,, ,,
,,	13	42	0	0	,, ,,
,,	14	42	0	0	,, ,,

Spelter (ordinary).

		£	s.	d.	
July	8	33	18	9	inc 2/6
,,	9	34	1	3	,, 2/6
,,	12	34	6	3	,, 5/-
,,	13	34	7	6	,, 1/3
,,	14	34	7	6	No change

Lead (English).

		£	s.	d.	
July	8	32	0	0	No change
,,	9	32	0	0	,, ,,
,,	12	32	10	0	inc. 10/-
,,	13	32	15	0	,, 5/-
,,	14	33	0	0	,, 5/-

AVERAGE MONTHLY PRICES OF STEEL SHIP ANGLES (NORTH OF ENGLAND).

Year.	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Yearly Average
	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
1896	4 15 0	4 17 6	5 0 0	5 0 0	5 0 0	4 17 6	4 17 6	4 17 6	4 17 6	5 0 0	5 7 6	5 7 6	4 19 9
1897	5 7 6	5 7 6	5 7 6	5 5 0	5 0 0	5 0 0	5 2 6	5 2 6	5 2 6	5 2 6	5 0 0	5 5 0	5 3 5½
1898	5 5 0	5 5 0	5 5 0	5 7 6	5 13 9	5 15 0	5 15 0	5 15 0	5 17 6	6 0 0	6 5 0	6 7 6	5 14 3½
1899	6 10 0	6 12 6	6 15 0	6 15 0	6 17 6	6 17 6	7 0 0	7 0 0	7 5 0	7 5 0	7 12 6	7 15 0	7 0 5
1900	7 15 0	8 0 0	8 2 6	8 5 0	8 5 0	8 7 6	8 7 6	8 2 6	8 2 6	8 0 0	7 10 0	7 10 0	8 0 7
1901	6 15 0	6 12 6	6 5 0	6 0 0	6 0 0	5 10 0	5 15 0	5 17 6	6 0 0	5 17 6	5 17 6	5 15 0	6 0 5½
1902	5 12 6	5 10 0	5 10 0	5 12 6	5 12 6	5 12 6	5 12 6	5 12 6	5 12 6	5 12 6	5 12 6	5 7 6	5 11 8
1903	5 6 3	5 6 3	5 7 6	5 12 6	5 12 6	5 10 0	5 10 0	5 10 0	5 10 0	5 10 0	5 10 0	5 0 0	5 8 9
1904	5 0 0	4 17 6	5 2 6	5 5 0	5 5 0	5 5 0	5 5 0	5 5 0	5 0 0	5 0 0	5 0 0	5 5 0	5 2 6
1905	5 5 0	5 7 6	5 10 0	5 10 0	5 10 0	5 10 0	5 10 0	5 10 0	5 12 6	6 2 6	6 12 6	6 12 6	5 14 4
1906	6 12 6	6 12 6	6 12 6	6 12 6	6 12 6	6 12 6	6 12 6	6 12 6	6 12 6	6 12 6	6 12 6	7 2 6	6 13 4½
1907	6 17 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	6 12 6	6 12 6	7 0 5
1908	6 2 6	6 2 6	6 2 6	5 17 6	5 17 6	5 17 6	5 17 6	5 12 6	5 12 6	5 12 6	5 12 6	5 12 6	5 16 3
1909	5 12 6	5 12 6	5 12 6	5 12 6	5 12 6	5 7 6	5 7 6	5 7 6	5 7 6	5 7 6	5 7 6	5 7 6	5 9 7
1910	5 16 3	5 17 6	5 17 6	6 1 6	6 2 6	6 2 6	6 2 6	6 2 6	6 2 6	6 7 6	6 7 6	6 7 6	6 2 3
1911	6 7 6	6 7 6	6 7 6	6 7 6	6 7 6	6 7 6	6 7 6	6 7 6	6 7 6	6 7 6	6 7 6	6 9 0	6 7 8½
1912	6 16 3	6 17 6	6 17 6	7 5 0	7 7 6	7 7 6	7 7 6	7 12 6	7 12 6	7 12 6	7 14 6	7 17 6	7 7 4½
1913	7 17 6	7 17 6	7 17 6	7 17 6	7 17 6	7 17 6	7 17 6	7 11 6	7 7 6	6 15 6	6 7 6	6 2 6	7 8 11½
1914	6 2 6	6 2 6	6 2 6	6 2 6	6 2 6	5 15 0	5 15 0	6 15 0	7 0 0	7 1 3	7 5 0	6 8 7½	
1915	7 17 0	8 5 0	8 17 6	9 5 0	9 5 0	9 15 0	9 15 0	9 15 0	9 15 0	9 15 0	10 15 0	10 15 0	9 8 3½
1916	11 3 1½	11 2 6	11 2 6	11 2 6	11 2 6	11 2 6	11 2 6	11 2 6	11 2 6	11 2 6	11 2 6	11 2 6	11 2 6½
1917	11 2 6	11 2 6	11 2 6	11 2 6	11 2 6	11 2 6	11 2 6	11 2 6	11 2 6	11 2 6	11 2 6	11 2 6	11 2 6
1918	11 2 6	11 2 6	11 2 6	11 2 6	11 2 6	11 2 6	11 2 6	11 2 6	11 2 6	11 2 6	11 2 6	11 2 6	11 2 6
1919	11 2 6	13 12 6	13 12 6	13 12 6	17 2 6	17 1 3	17 0 0	17 15 0	17 15 0	17 15 0	17 17 6	18 5 0	16 1 9½
1920	19 10 0	20 0 0	21 10 0	22 0 0	23 5 0	24 0 0	24 0 0	24 0 0	24 15 0	24 10 0	24 0 0	24 0 0	22 19 2
1921	22 10 0	20 12 6	19 0 0	17 10 0	17 10 0	16 6 0	14 10 0	14 3 4	13 10 0	11 15 0	10 0 0	9 12 6	15 11 7
1922	9 17 6	10 0 0	10 0 0	10 0 0	10 0 0	9 17 6	9 10 9	8 15 7½	8 14 0	8 12 6	8 12 6	8 12 6	9 7 8½
1923	8 18 1½	9 1 3	9 14 0	10 0 0	10 0 0	10 0 0	9 8 9	9 9 6	9 10 0	9 8 9	9 11 6	9 18 9	9 11 8½
1924	10 0 0	9 18 1½	9 17 6	9 17 6	9 17 2	9 11 3	9 15 0	9 15 0	9 9 4½	9 6 6	9 5 0	9 5 0	9 13 1½
1925	9 2 0	9 0 11½	9 0 0	8 15 9	8 10 3½	8 9 0½	8 6 3	8 2 6	7 19 0½	7 12 3	7 5 0	7 2 6	8 5 5½
1926	7 2 6	7 2 6	7 2 6	7 3 4	7 2 6	7 3 9	—	—	—	—	—	—	7 2 10½

WILLIAM JACKS & COMPANY,

WINCHESTER HOUSE, OLD BROAD ST., LONDON, E.C.2.

18, BENNETTS HILL, BIRMINGHAM.

18, BENNETTS HILL, BIRMINGHAM.
11, OLD HALL STREET, LIVERPOOL.
EXCHANGE BLDGS., PORT TALBOT.
FOWLERS BUILDINGS, BOMBAY.
CLIVE STREET, CALCUTTA.
ANGAPPA NAICK STREET, MADRAS.

REGISTERED TRADE MARK
LIMPET

1, HONG KONG ROAD, SHANGHAI.
OCEAN BUILDING, SINGAPORE.
JAVA STREET, KUALA LUMPUR
5, SHAFFRAZ ROAD, RANGOON.
COX'S BUILDINGS, KARACHI.
P.O. BOX 1580, CAIRO.

PIG IRON

SCOTCH, MIDDLESBRO', HEMATITE, BASIC, SPECIALS, &c.,

NON-FERROUS METALS

COPPER, TIN. LEAD, SPELTER, ANTIMONY, CHROME ORE

WILLIAM JACKS & COMPANY,

19, ST. VINCENT PLACE, GLASGOW.

ZETLAND ROAD, MIDDLESBROUGH.

SMALL ADVERTISEMENTS.

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